Nitin Upadhyay

UnBlock the Blockchain

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Nitin Upadhyay
Chair and Head Centre for Innovation
Goa Institute of Management
Goa, India

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Dedicated
To
Avatar Meher Baba

I have come to sow the seed of love in your hearts, so that, in spite of all the superficial diversity which your life in illusion must experience and endure, the feeling of Oneness, through Love, is brought about amongst all nations, creeds, sects and castes of the world
Meher Baba

To Shalini, Meherika and Brownie for showering unconditional love

Preface

The Internet helped many organizations and people around the world to reduce the cost of participation, contribution, collaboration, and exchanging information, but it failed to promise the security of our identity, transaction integrity, and trust. Initially, the Internet was not designed to transfer "*value*" but had structure, format, and protocols by which people could share, communicate, and collaborate. Blockchain is transforming not just the digital world, by incorporating transactions of "*value*," but also the human society. We can observe the tremendous potential of the technology in shaping the digital and shared economy. There is the growth in the interest among the researchers, industry, and academia to study and leverage the potential of blockchain. Despite having high expectations from the blockchain technology, there is a lack of knowledge to understand the challenges, potential opportunities, applications, and business transformations. Considering the significant nature of the blockchain, this book presents a state-of-the-art progress in the blockchain domain. An attempt in the book is made to comprehensively and elaboratively present and discuss the pertinent and potential challenges, opportunities, applications, values, and business transformations associated with the blockchain. The different stakeholders associated with the blockchain—scholars, practitioners, and leaders are the prime beneficiaries of this book.

This book considers the apt and balanced way of addressing the topics in a lucid and readable fashion.

In this book, I introduced a broad array of concepts and approaches that one can use in many ways, such as to

- Explore the status of Web evolution and value ecosystem
- Understand the utility of blockchain ecosystem
- Identify the development in blockchain platforms
- Reduce messiness—transaction and agency costs
- Develop, assess, and evaluate business models
- Understand the roadblocks—challenges
- Strategize blockchain idea brainstorm and evaluation.

I have organized this book in a structured, modular, and easy-to-read access format. For the readers, it provides benefits as a potential guide and a reference for critical pointers.

Chapter 1: Web of Value

Blockchain has redefined the World Wide Web as "*Web of Value*." It has empowered people to publish, distribute, and sell information, services, and products of "value" anywhere through this Web without the involvement of any intermediaries. It has become easy for people to build new relationships, businesses, and networks by leveraging the blockchain technology, thereby able to send, share, and receive the value. In this chapter, readers will understand the phenomenon of "*Web of Value*" and explore the landscape of value generation as driven by the blockchain technology.

Chapter 2: Rule of Code

Blockchain involves no intermediaries. The value is between the sender and the receiver. In this chapter, readers will be exposed to the various facets of the blockchain and consensus mechanisms. Further, specific discussion on the emergent segment of blockchain applications is also covered.

Chapter 3: Messy

Applicability of blockchain is massive in business contexts, but the value comes through addressing the two core elements—technology and management—of the blockchain. In this chapter, readers will get to know the impeccable capability of the blockchain to reduce messiness—transactions and agency costs and application portfolios.

Chapter 4: Business Models

The Internet has created new possibilities that we did not foresee in its early years. Blockchain technology is unique and has great potential to penetrate existing markets and to develop new markets. In this chapter, readers will understand the business models for blockchain technology. It will help them to know how a current business can be transformed and also how to create new markets.

Chapter 5: Roadblocks

Adoption of a blockchain technology is challenging in terms of both feasibility and viability to both parties involved in generating the values. In this chapter, readers will understand the roadblocks—challenges—in the blockchain space, thereby enabling them to charter appropriate strategies and tactics.

Chapter 6: Big Ideas

Blockchain is disrupting every domain of the business and part of human life and society. What is your big idea? In this chapter, readers will be exposed to conceive, design, and develop their big ideas for blockchain space to disrupt the market.

Chapter 7: Success Stories

Successful organization showcase strength, commitment, risk-taking ability, and leadership excellence. In this, chapter success stories of ten different companies are discussed. The readers will be able to understand the challenges, opportunities, and useful lessons of blockchain solutions.

Appendix: Worksheet Activities

In this part of the book, various worksheets are proposed to help the CXOs, leaders, consultants, senior executives, and practitioners to explore and understand the pathway needed to transform the organization. It will help the organization entering into the blockchain space. It helps the organization to focus on guiding principles to execute its efforts and investments, and to ensure that those are as per the corporate priorities considering culture, governance and transition, and monetization and value generation, and to mitigate any risks.

Goa, India
June 2019

Dr. Nitin Upadhyay

About This Book

- Avoids the complex technical jargon and provides reliable, concise information on the real benefits, usage, and operationalization aspects of blockchain.
- Unfolds how the existing business models will be either changed or customized to meet the needs of the transaction of values.
- Illustrates the process to conceive, design, and develop big ideas for blockchain space to disrupt the market.

This uniquely accessible book helps the reader to understand pertinent and potential challenges, opportunities, applications, values, and business transformations associated with the blockchain. It avoids the complex technical jargon and provides reliable, concise information on the real benefits, usage, and operationalization aspects of blockchain. This book discusses the impact of blockchain in business models, business environments, and businesses. Moreover, it unfolds how the existing business models will be either changed or customized to meet the needs of the transaction of values.

The different stakeholders associated with the blockchain—scholars, practitioners, and leaders—are the prime beneficiaries of this book. Blockchain is disrupting every domain of the business and part of human life and society. What is your big idea? In this book, readers will be exposed to conceive, design, and develop their big ideas for blockchain space to disrupt the market and attain the competitive advantage.

What you will learn, concepts and approaches that you can use in many ways, such as to

– Explore the status of Web evolution and value ecosystem
– Understand the utility of blockchain ecosystem
– Identify the development in blockchain platforms
– Reduce messiness—transaction and agency costs
– Understand the roadblocks—challenges
– Develop, assess, and evaluate business models
– Strategize blockchain idea brainstorm and evaluation.

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About the Author

Dr. Nitin Upadhyay is a researcher, inventor, innovator, consultant, leader, coach, academician, and a prolific writer. He is an influencer and a regular contributor as "Bloggist" to Times of India, Economic Times and India Times. He is a *Fellow of the prestigious Royal Society of Arts London and Fellow of Institute of Engineers (I)*. Over the years he has engaged with select top Fortune 500 companies. He is a leading authority and speaker on innovation, design, cloud computing, big data & analytics, future technology, and user experience. He is currently working in the area of information technology and is a core member of the Big Data Analytics programme, Goa Institute of Management, India. He is also the Chair and Head of the Centre for Innovation at Goa Institute of Management. He has wide industry, academic, consultancy, and research experience and is a Member Board of the Governors and an Executive member and Chair of Cloud SLAs (service-level agreements) for the Cloud Computing Innovation Council of India. He has worked with Samsung Advanced Research at South Korea and Bangalore for many flag-ship projects and drove the whole gamut of innovation. He has contributed 100+ peer-reviewed publications/presentations/posters/talks and 12 books.

Chapter 1
Web of Value

In the future, it might seem just as strange to say that I am trusting a third-party institution with my interests as to say that I'm using an abacus today.

—Gavin Wood Ethereum Co-founder

Abstract Blockchain has redefined the World Wide Web as "Web of Value." It has empowered people to publish, distribute, and sell information, services, and products of "value" anywhere through this Web without the involvement of any intermediaries. It has become easy for people to build new relationships, businesses, and networks by leveraging the blockchain technology, thereby able to send, share, and receive the value. In this chapter, readers will understand the phenomenon of "Web of Value" and explore the landscape of value generation as driven by the blockchain technology.

Introduction

The foundation of human civilization is "trust" that helps human to evolve, create relationships, build societies and communities, and generate values. Trust plays a critical role not only in nurturing societal balances but also in shaping the businesses. The digitization has affected all of us and has blurred the physical boundaries. People need not to travel for the business, and with the digital infrastructure, it has became possible to conduct business, establish partnership, and collaborate seamlessly with people from different geographical locations and time zones.

Nonetheless, soon after the Internet got commercialized, it has undergone several transformations to shape society. The early adopters of the Internet in the 1990s used it as the gold mine and generated exponential growth of the business. They understood the worth of the Internet for representing not just their virtual face and brand but supporting business processes and business life cycle. The industries could showcase their services and products and outreach to the customer base unimagined earlier. The Internet helped the business to increase the reachability and visibility. The limitations of the first generation of Internet, web 1.0, was that the

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customers or the end users could hardly contribute to the overall evolution until they were hit by the second phase of the Internet, web 2.0, where they were provided with channels for communication, coordination, and collaboration. This growth of the Internet allowed everyone to participate and to become the consumer and producer of the content and services. Besides, the mobility and the development of the smart infrastructure added the extra advantage to make Internet access from anywhere on any device, which leads to its democratization. Table 1 summarizes the Web transformation.

Long before the money was introduced to the world, people adopted multiple systems to execute the transaction in place of the fruitful business exchanges between the involved parties. "Barter system," first adopted by Phoenicians and introduced by the Mesopotamian tribes, is one of the most widely used business systems whose roots could be traced way back to 6000 BC. People could exchange services and goods for other services and products in return. But it was not easy to perform such exchanges, first, due to the inherent complexity of the trust uncertainty between the people and secondly, because of the deviation in the assessment of the value of the goods and the services. Nonetheless, it is also imperative that if many people want something—"service," "goods," or any "object"—then it is bound to become "valuable" at least in terms of perception. There was no common market place where people could understand the value for their goods and services and thus were sometimes got cheated by other parties by getting no/less benefit. To avoid such complexities and to reduce the "cognitive load" by which people could agree on the similar terms to get involved in the exchanges/trading, coinage system was introduced.

In the early stage of the coinage system, community or tribes developed/identified objects (having specific carving, designs, or aesthetics) to be treated as valuable and could be used during the trade. Though such a system was undoubtedly better than the barter system, as a group or a community has to agree on the value of the object to be used during a trade, it poses a severe valueless transaction if those objects (not recognized and treated as valuable) were used outside their trade community. People could establish the trust which could lead to the trade within the community, but outside the community, it was a far reach goal. Some form of standardization for the business was lacking, and around 600 BC the

Table 1 Web transformation

Web x.0	Description
Web 1.0	Primarily focus on the information showcase which allows people to view and search for the information, known as the "read-only" Web
Web 2.0	The focus shift on sharing, collaborating, communicating, and coordinating landscape. The inclusion of "read–write" by incorporating "user-generated content" Web was transformational
Web 3.0	The focus is on "read–write–perform" driven by decentralization and transfer of "values"

first official currency (Beattie 2019), a metal piece mixture of silver and gold stamped with picture acted as denominations, was minted by Lydia's King Alyattes. Lydia's currency helped the country to increase its economic benefits by performing internal and external trades. People got several advantages due to the presence of the metal coins; first, the marketplace trade price was under control and second, they had the trust-driven community for the trade out spring of the phenomenon of the coinage system. The rise of the centralized trusted party begun. To circumvent the market leader of Lynda's country for the metal currency, later China introduced the paper currency to capture the market and the economy. European used coins until the sixteenth century. The trading system was functional, and trust was prevalent during the business trade as the involved parties get the fair price for the goods and services. As more and more trade begun to happen between internal and external parties, the other consequence, apart from the business, was the increase of the theft epidemic. The centralized authority helped the community to save their money (metal coins/paper currency) and trust came into existence. Now, parties could transact for trade through these central authorities, which were governed by rules and regulations.

To perform safe transactions between unknown parties, these central authorities started claiming extra transaction fees to validate that the deal that happen between parties is fair and legal. Parties were navigated through the trusted third party to perform any trade or transactions resulting in the involvement of a decidedly less cognitive load. One has to trust the central authority and then initiate/execute the transaction or the business. The advent of the first and second waves of the Internet transformed the market through the use of e-commerce-driven solutions by these trusted third parties. The Internet supported the evolution of the business to be performed, first, by executing digital processes; second, by involving trusted third parties without even getting the trouble of establishing complex internal, external, and foreign trades; third, by breaking the barriers not only in terms of time and space but also by the physical proximity; and lastly by approaching the masses and new territories.

Though the Internet helped many organizations and people around the world to reduce the cost of participation, contribution, collaboration, and exchange of information, it failed to promise the security of our identity, transaction integrity, and trust. Initially, the Internet was not designed to transfer "value" but had structure, format, and protocols by which people could share, communicate, and collaborate. The Internet had limitations to execute peer-to-peer transactions such as a payment that would be possible only when a trusted third party (Bank, Governments, Uber, Airbnb, PayPal, etc.) is involved. Moreover, a value such as land rights or access to private property was not at all supported by the Internet (considering no intermediaries). Internet was further limited by its design to protect, track, and transfer things of value. The world was waiting for another paradigm shift of the Internet. The Internet has manifested human society, and our virtual presence and involvement. Yesteryears, we all have witnessed the rise of the Internet era of "value," web 3.0, and its transformation leading to the trust-free economy. The Web transformation is shown in Fig. 1.

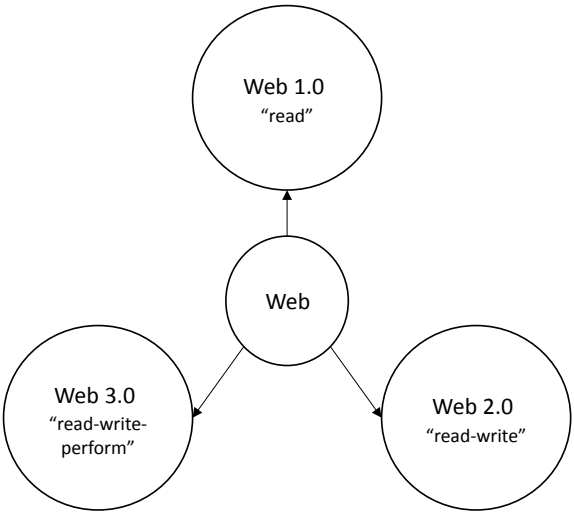

Fig. 1 Web transformation

Evolution of Web

The Web provides an interplay of applications, services, platforms, and content. In the early 1990s, the Web emerged as the global ubiquitous connected hyperlinked system, but its network effects were still unclear. The search engines that we see today are different in terms of the capacity and capability of the search that could be performed as compared to the early search engines like Alta Vista and Yahoo. It is the development of the digital communication infrastructure such as broadband solutions and services, and Wi-Fi ignited the growth of the Web. As the Web getting transformed due to its network effects, new technologies were developed to make sense of this unpretentious growth of the Web.

Web 1.0

The web 1.0 supported the publishing and accessing of the documents available online through the browser. The protocol—hypertext transfer protocol (Http)—and the language—hypertext markup language (HTML)—paved the growth of the Internet. The earlier standards looked at the document publishing/rendering aspects so that the readers could read it. To some people, the first wave of Web was the technological network of servers accessed through the Internet. In such a network, each node refers to the server, and the edge is the link/connection to the server to push/publish the documents. During 1990, the Web-hosted and served around 50 web pages. Today, it is challenging to measure the full coverage of the density of

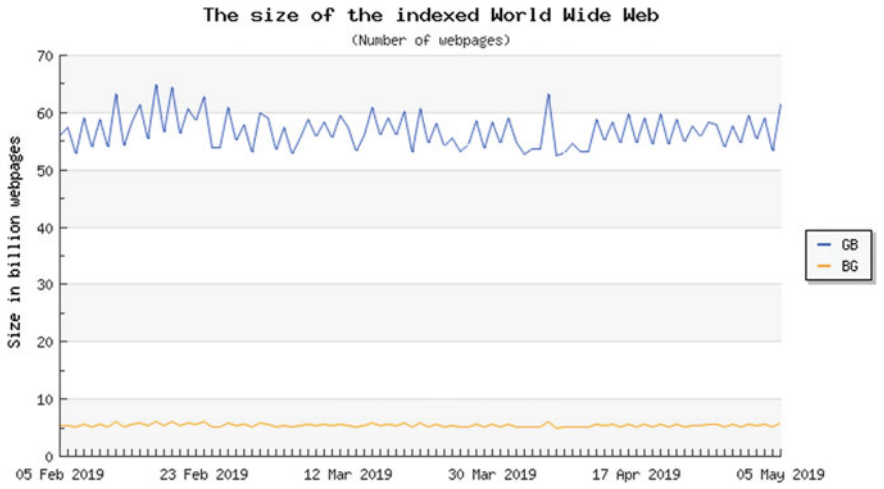

Fig. 2 Size of the indexed world wide web (GB: sorted of Google and Bing; BG: sorted on Bing and Google)

the Web. Roughly, the size of the indexed Web is around 5.21 billion web pages as of May 6, 2019 (source: http://www.worldwidewebsize.com) (Fig. 2).

An essential component to access those web pages was a search engine, and people could access web pages to get the information. Such a Web refers to the Web of information (documents) of the read-only Web.

Web 2.0

At the end of the 1990s, the semantic Web growth has begun with the vision to provide meaning to the Web content. The semantic Web started with two purposes: first, to leverage knowledge reasoning and representation to give sense to Web content and second, to allow agents to initiate and perform complex tasks for users. The emergence of the e-commerce business models and scalable and meaningful information discovery led to an enormous network effect and increased the user base. The indirect network effects were also promising; for example, the additional Web sellers were involved in the marketplace, and users could also provide value to the sellers by giving reviews, feedbacks, and comments. Also, the crowd-based collective intelligence of the users enabled to develop the enormous Wikipedia, a global repository of the knowledge. People could also contribute content to the Web (for example, blogs), share the content on the social media platform (for example, Facebook), and engage in collectively organization and structuring information (for example, wikis).

Further, the developments of the communication networks and infrastructures lead to the emergence of video content services, contribution by the users (for example, YouTube). Network effects were tremendous in not only increasing the number of active users but also the in developing and sharing the content across the platforms. The mash-up services helped different platforms to combine data and present it into a more meaningful way. Such a Web was revolutionary in including people as active contributors. The connected Web has nodes that include people or resources, and the edges could represent a connection between people or contribution from people or links between resources. The emergence of social network platforms enabled the human race to collaborate, partner, coordinate, and share.

Moreover, the trust began to shift toward machines and recommender system. The big companies like Amazon, Google, Facebook, and LinkedIn started their growth journey by leveraging long digital trail of the users. Further, users, in turn, benefited from these companies by getting themselves engaged, entertained, and by also getting an excellent and fair deal over services, products, and offers. By now, we could see the rise of two types of users: first, the digital immigrants, who were part of the web 1.0 era and second, digital natives who were born in the web 1.0 era and started using digital services/contents from an early age.

Web 3.0

The content available on the Internet can easily be copied, reused, and forged and thus pose a threat and challenge to the ownership and rights of the parties. Internet faces a severe problem of managing and securing the "values." One can make a copy of the image or a video file and can claim it as is his/her work. We all are drowning in fake news, forged content, copied, and reused digital artifacts. It is the need of an hour to find the silver lining in the sky and revive our hope to discover the transaction of value to validate our ownership and secure and access information, identities, and objects.

Blockchain give rise to the non-intermediaries by which no intermediaries are allowed to participate, and trust is achieved through the participative ability of the collective peer-to-peer involvement. Such involvement will have a severe impact on the organizations where they interact with various stakeholders such as customers, suppliers, vendors, etc. to revive and reformulate their value chain. For years, people were involving intermediaries for money transactions to establish and execute trade and businesses but in situations where the transfer of value in a reliable way will change the dynamics of the financial intermediaries. Various technologies like virtual reality, augmented reality, and neuroscience are taking mainstream and impacting the business and customer experience of getting services, and goods. We are a combination of physical and virtual (digital) world. Initially, we were lacking in capturing the "ownership" in the digital world, and with the help of blockchain that missing layer can be established. By blockchain

layer, one can achieve transactions of value, secure way of accessing information, and identities.

The advocates of the trust-free economic transactions started promoting blockchain technology as the underlying mechanism to attain the Internet of value. One of the leading Research Firm, Gartner, claims blockchain technology to impact the business. Due to the appearance of the digital cryptocurrency, Bitcoin, blockchain technology got immediate fame. The fundamental principle behind the blockchain technology is the notion of a public decentralized and distributed ledger available to the participating parties. Besides, it uses the trust-embedded protocol through smart contracts. Markets and Markets projected the growth of blockchain investments from US$ 210 million in 2016 to US$ 2.3 Billion in 2021 (Transparency Market Research 2017). Another research report, transparency market research, predicts the rapid adoption of blockchain and sales of related technology to grow to US$ 20 billion by 2024 from US$ 316 million in 2015 (Markets and Markets 2016). Such humongous growth of investments and technological advancements in sales and adoption help to develop a sustainable ecosystem for the growth potential of the blockchain in various domains and industries.

The advocates of the blockchain technology argue that it has the potential to promise the trust-free economic transactions (Glaser 2017). Moreover, Gartner (2016) claims that blockchain technology, in the near future, will impact the business and currently considered as the most trending technology. The blockchain technology is continuously evolving since it was coined in the year 2008, and researchers, scholars, and practitioners are finding new ways of working with the blockchain technology (Davidson et al. 2018). Bitcoin is the first decentralized peer-to-peer application of the blockchain gained immediate fame (Beck and Muller-Bloch 2017). Through Bitcoin, it becomes possible to perform transactions of value, including buying and exchanging of goods and services, via digital transaction using digital currencies. Figure 3 shows the Google trend data for Bitcoin and blockchain. The applications of the blockchain are not limited to the

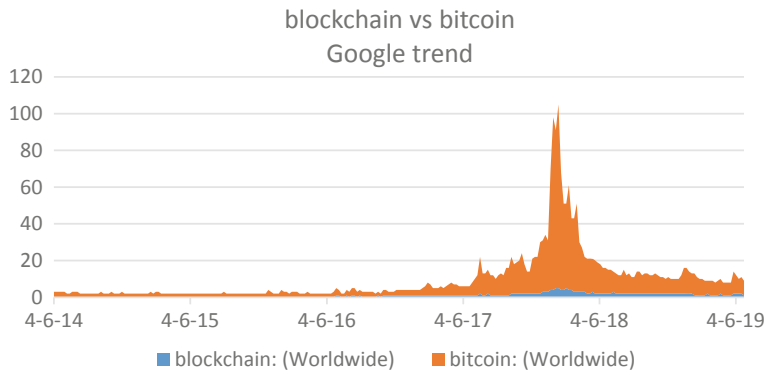

Fig. 3 Google trends: Blockchain versus Bitcoin

financial services, and evidence have shown its widespread coverage to various domains that coordinated the valuable information and governed by central authority and intermediaries (Wright and De Fillippi 2015). To perform the transaction of any asset digitally, it requires two foundational principle—*distributed consensus* and *anonymity*.

One can track, identify, and verify the historical transactions of value by leveraging the *distributed consensus model.* Blockchain technology maintains the ever-growing list of records in a decentralized, distributed fashion confirming to the participating nodes. All the participating nodes in the blockchain network have access to the single version of the truth, and the information about every transaction is placed and is available in a public ledger. Moreover, the participating nodes are treated as anonymous. Despite having high expectations from the blockchain technology, there is a lack of knowledge to understand the challenges, potential opportunities, and applications.

Blockchain in Action

In 2017, a game named CryptoKitties, based on Blockchain technology, started gaining momentum and acceptance among the players (Cryptokitties 2018). The game allows the players to purchase, breed, trade, sell, and feed unique digital kittens. One can achieve the transaction of values, digital kitties, and cannot falsify the information. CryptoKitties are the ERC721 token and thus digitally collectible like any other physical characteristics, for example, a Pokemon card. Each CryptoKitty has a unique DNA, and a player can buy and breed CryptoKitties with the help of the token Ether. Each kitty can be fed and nurtured to make it more valuable, and the status is maintained at all the blockchain networks. Such kind of information avoids forgery or falsification of the ownership. Currently, the commercial trade for the CryptoKitty varies to the range of $100,000, and the total collection reaches to $20 million. But the transfer of ownership not only just applicable to digital assets, such as CryptoKitty, but it can also be applied to the physical assets by the way of assigning unique identities in the process of tokenization (Hoff et al. 2017).

Assets like property, automobiles, etc. can be verified at any time for the ownership from the participating blockchain network nodes. The authenticity of the information, for example, a physical property attached with a digitally unique identity, and digital ownership is the main challenge. Everledger is a diamond verifier company that has introduced the blockchain network and streamlined the process accordingly. Now, it is easy to verify the source of the diamond and the ownership. Each diamond is given a unique digital identity, and the information of the diamond throughout its whole value chain is attached to the digital identity. People can verify the provenance of the diamonds and can avoid buying the stolen, unethically mined, and smuggled diamonds. Multiple stakeholders like insurance companies and transporters can join the network as they also get the information about the ownership and

can help the owners in case of a loss of diamond (owners get the compensation if a diamond is insured). Well, that is revolutionary and supportive that assists the stakeholders in becoming more vigilant and active.

The impact of the Blockchain can be seen in business models, business environments, and businesses. Digital identities will become the new dimensions to the products and services. All over the world, there is a rise in the conceptualization of number of national electronic identification (eID) programs to assign eID to every individual. Once an individual is assigned the eID (as per the biometric or other active profile) on the blockchain, then it is easy for an individual to not only capture the financial history but other required transactions of values. One potential use case would be to apply for a loan, and the credit history of the person would be verified on the blockchain network. Perhaps, digital identities are not restricted to people but can also be assigned to other objects such as products in the business and help to reshape the ownership in the digital world. Besides, it will change the dynamics of the retail market, and people would easily trade peer-to-peer without involving the intermediaries. Moreover, the product portfolios would end up in getting diversified raising to more business opportunities, as "proof of authenticity" and digitalization of the physical assets are materialized.

The existing business models either will be changed or customized to meet the needs of the transaction of values. One of the fundamental principles for the big companies to gain profit is to increase certain factors, i.e., strategize mass production and sale, and in turn, optimize/minimize the pricing for the products. But with the help of blockchain and other technologies like automation, robotics, and smart contracts, one can realize small deals with multiple customers. Consider an example where an individual would want to lease/rent its device's data storage. Even a tiny portion like 1 MB of the data storage could be rented/leased attaining to the decentralized model principles, and the overall impact would be on the existing business models for the companies like Dropbox, as there is no need of the intermediaries for the transaction. It is an advantage to the participating actors in the transaction of value. Such kind of models will give rise to the entire new economy —microeconomy. Due to the microeconomy model, the business opportunities that were not possible earlier could now be materialized, and user-driven business models will be positioned as direct competitors to the existing companies.

Concluding Remarks

The Web has been transformed to incorporate the transactions of value and that will change the dynamics of the society and business systems. Blockchain technology is the most trending technologies with the promise to impact businesses. The

blockchain technology has two critical dimensions—*distributed consensus* and *anonymity*—and applies to any digital asset transaction exchanged digitally (online). It is the foundation for trust-free economic transactions. The impact of the blockchain can be seen in business models, business environments, and businesses. The existing business models either will be changed or customized to meet the needs of the transaction of values.

References

Beattie, A. (2019). Retrieved May 14, 2019, from https://www.investopedia.com/articles/07/roots_of_money.asp.

Beck, R., & Muller-Bloch, C. (2017). Blockchain as radical innovation: A framework for engaging with distributed ledgers. In *50th Hawaii international conference on system sciences*.

Cryptokitties. (2018). Retrieved April 02, 2019, from https://www.cryptokitties.co.

Davidson, S., De Filippi, P., & Potts, J. (2018). Blockchain and the institutions of capitalism. *Journal of Institutional Economics*.

Gartner. (2016). *Gartner's 2016 hype cycle for emerging technologies*. Retrieved October 25, 2018, https://www.gartner.com/newsroom/id/3412017.

Glaser, F. (2017). Pervasive decentralisation of digital infrastructures: a framework for blockchain enabled system and use case analysis. In *50th Hawaii International Conference on System Sciences (HICSS 2017)*.

Hoff, S., Lokøy, E. & Nyberg, O. (2017). Digitalization of real-world assets by using the blockchain technology—A case study of commercialized blockchain technology, and its potential use in the Norwegian street art market. Western Norway University of Applied Sciences.

Markets and Markets. (2016). Blockchain Market by Provider, Application (Payments, Exchanges, Smart Contracts, Documentation, Digital Identity, Clearing, and Settlement), Organization Size, Vertical, and Region-Global Forecast to 2021; 2016.

Size of the indexed world wide web. Retrieved April 02, 2019, from http://www.worldwidewebsize.com.

Transparency Market Research. (2017). Retrieved April 02, 2018, from http://www.prnewswire.com/news-releases/worldwide-blockchain-technology-market-is-anticipated-to-exhibit-a-cagr-of-587-between-2016-and-2024-elimination-of-third-parties-improves-demand-and-security-of-online-transactions–tmr-611067345.html.

Wright, A., & De Filippi, P. (2015). *Decentralized blockchain technology and the rise of Lex cryptographia*. SSRN http://ssrn.com/abstract=2580664.

Chapter 2
Rule of Code

Unless you know the code, it has no meaning the future.
—John Connolly, The Book of Lost Things
We all force our true selves into little hashes and show them like passwords. A smile is a hashing function, and a word, and a cry. The cry is not the grief, the word is not the meaning, and smile is not the joy: we cannot run the hash in reverse, we cannot get from the sign to the absolute truth. Maybe the smile is false. Maybe the grief is a lie.
—Seth Dickinson, The Monster Baru Cormorant

Abstract Blockchain involves no intermediaries. The value is between the sender and the receiver. In this chapter, readers will be exposed to the various facets of the blockchain and consensus mechanisms. Further, a specific discussion in the emergent segment of blockchain applications is also covered.

Introduction

To be able to utilize the potential of blockchain technology, it is necessary to understand the different components of the technology and the prevalent architectures to embrace business opportunities. Blockchain is still a nascent technology, and businesses are unaware of the business use cases, technology know-how, and business opportunities. Blockchain, a distributed ledger technology, has already elevated the expectations of the advocates of the technology. The introduction of the virtual currency application, Bitcoin, has given instant fame to the technology.

Further scholars are considering the technology not only in financial domains but also in nonfinancial fields and they claim that the technology will help to develop applications for "any form of asset registry, inventory, and exchange, including every area of finance, economics, and money; hard assets (physical property); and intangible assets (votes, ideas, reputation, intention, health data, information, etc.)" (Melanie 2015). So far, the only acclaimed viable solution is the Bitcoin. And although there has been evidence in research and industry to achieve more out of blockchain technology, very little work has been materialized (Rizzo 2016).

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Blockchain technology works on the peer-to-peer distributed and decentralized consensus-based transactions. Every participating node (computing technology) appears in the potential consensus and transactions to generate an immutable transaction log of values (ownership).

Blockchain

The advocates of the blockchain technology have deliberated and discussed the use of it to deliver the business value by achieving the value of transactions on the peer-to-peer decentralized and distributed consensus mechanisms and distributed ledger technology. Though the technology has different meanings as per the concerned stakeholders' point of view, it is helpful to note that the blockchain technology can be seen as threefold structure (Mattila 2016):

- blockchain is a data structure;
- blockchain is a technology stack;
- blockchain is a social phenomenon.

Let us consider the first paper by Nakamoto (pseudonym) who has introduced the Bitcoin based on the blockchain technology. The Bitcoin, as presented in the article (Nakamoto 2008), refers to "*Peer-to-peer distributed timestamp server that generates computational proof of the chronological order of transactions*." It can be noticed that the paper itself does not mention the term blockchain though it presents the use of the technology to achieve Bitcoin transactions. Well, it is easy to relate that the chain of blocks is involved in the transactions and logical to use the term blockchain. Perhaps, it is difficult to get the details who has coined and where the term blockchain has appeared first in the documents. Some scholars and practitioners argue that the blockchain is just another complex data structure. It is comprised of linked lists containing variables of timestamps, hash function, and value information which is decentralized and distributed having set of protocols as "consensus" to fill the fields in the data structure; others have used the term to describe the blockchain as a social phenomenon that has been deemed "colloquial" (Mattila 2016). Few others have used the term blockchain to describe it as a technology stack, Fig. 1, to achieve the transactions of "value" where the stack comprises platform, applications, and blockchain ecosystem. In the platform level, the blockchain protocols such as Bitcoin, Ripple, Ethereum, and Hyperledger are emerging. The application level covers tools such as smart contracts to achieve the desired work. At the blockchain ecosystem level, a different (or not so different) ledger of ledgers is connected to cocreate the value. There exist various terminologies such as distributed consensus systems, distributed consensus ledgers, and replicated shared ledgers.

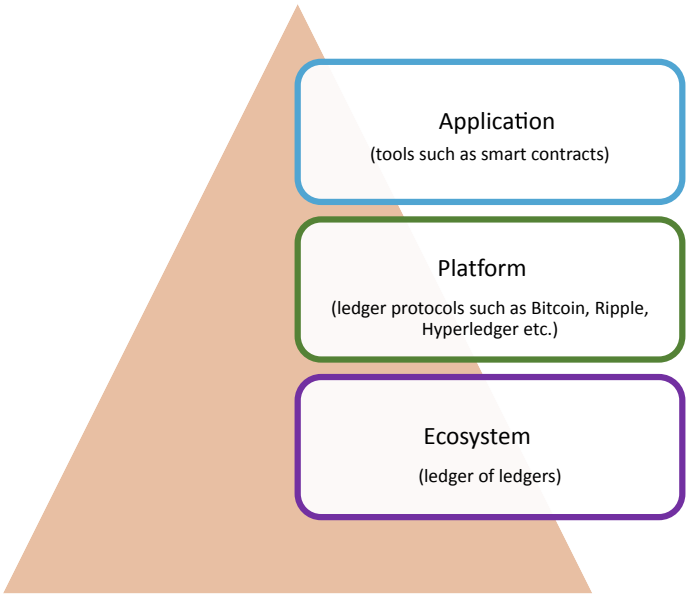

Fig. 1 Technology stack

Blockchain Network

The blockchain users run the same software on their computer to form a decentralized and distributed network where users can perform transactions, trade assets, and other entities of value. Blockchain eliminates the need for intermediaries, establishes trust, and avoids fraudulent in the transactions and ownership. The transactions that are verified and approved are stored in the blocks (chronologically, forming a chain of blocks). Due to the blockchain authenticated and validated ownership information, one can get information about the ownership and provenance of the data or transactions. Blockchain is now treated as the first internet-scaled open platform for value exchange. A simple blockchain network is shown in Fig. 2. Each participant of the network, termed as a node, holds a chain of blocks containing the validated chronological transactions details happened in the network. Further, each block holds the number of transaction whose size depends on the number of transactions accomplished at a particular time interval.

Blockchain utilizes cryptography to ensure the safety of the system. Each transaction is authenticated and validated through the cryptographic key to ensure that only the owner of the specific entity of value uses it for the transaction. Further, with the help of cryptography, it is painful and almost impossible to cheat the system and change the ledger. To change the content of the block in the ledger, one needs to change the complete blockchain (atleast 51% of the network) which is

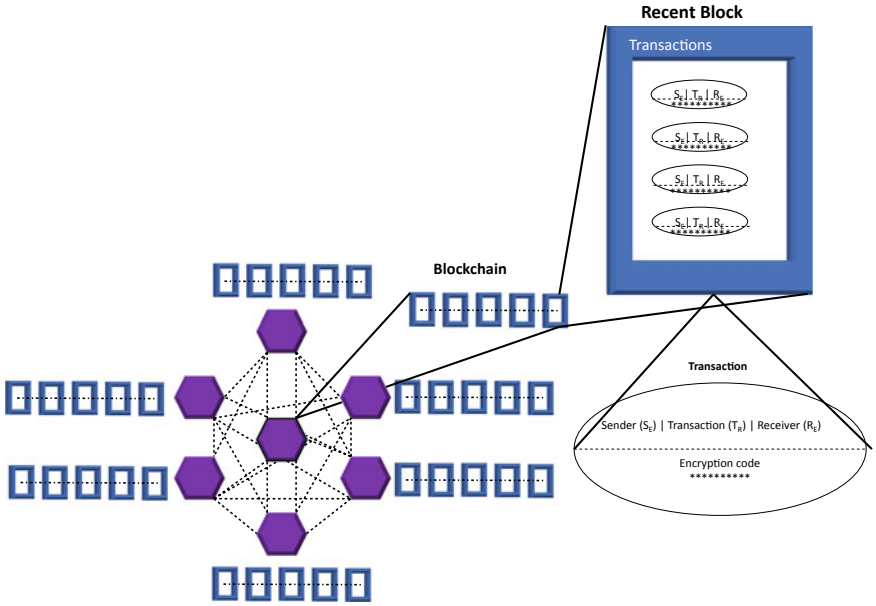

Fig. 2 Simplified blockchain network

Fig. 3 Process for blockchain transaction

computationally time-intensive and complicated (Zibin et al. 2017). Figure 3 demonstrates the five-step process of the blockchain transaction.

– Step 1: Transaction initiation
The "Sender" (S_E) wants to transfer an entity of value to the "Receiver" (R_E) and initiates a transaction. The S_E transmits the information about the transaction to the network. The transaction information comprises the R_E public address, the value of the transaction, and a cryptographic digital signature. The cryptographic digital signature helps to ensure the authenticity of the transaction.

– Step 2: Transaction authentication
The participating computing machines, termed as nodes, in a blockchain network, receives the transaction information and authenticate the validity. When the transaction is validated, it is placed in the pool of transactions.

– Step 3: Block creation
The pool of transactions is then placed in the block, an updated version of the ledger, by one of the participating nodes of the network. The node at a specific interval contains the block of transactions and broadcasts the block to the blockchain network for the validation.
– Step 4: Block validation
The participating nodes begin the validation process upon receiving the block of transactions. The validation process gets executed iteratively, which requires for its completion the consensus to agree from the majority of the network. There exist various validation techniques depending upon the type and nature of the blockchain. For example, "proof of work" is used by Bitcoin, while "the Ripple is using distributed consensus," and Ethereum uses "proof of stake." The purpose of each validation technique is to avoid forgery, fraudulent, and cheating and most importantly, confirming that every transaction is valid.
– Step 5 Block chaining
The block is "chained" into the existing blockchain, and updated blockchain ledger is broadcasted to the network. The whole process takes around 3–10 s.

Different Types of Blockchains

One of the fundamental aspects of the blockchains is that it needs the participating network of nodes to perform the transaction. Blockchain is broadly categorized into three types (Yli-Huumo et al. 2016):

Public (Permission-less ledger)
A public blockchain is an open blockchain where everyone is allowed to participate, initiate, and be available in the consensus process, see Fig. 4. Moreover, the blockchain ledger is available publicly to the participants and all the participating nodes that have the same information about the transactions. Currently, most of the cryptocurrencies are benefitted by the value of transactions by removing the intermediaries and lowering cost of transactions and run on the public blockchain architecture. The public ledger is also termed as permission-less into the transaction scheme. In such a scheme, everyone is free to download the distributed ledger as anonymous validator and can participate in the transaction process for authenticating, validating, and creating blocks and updating the blockchain. The on-chain assets, like Bitcoin, are the potential entity utilized for the transactions in the public chain as it is unsafe and uncontrollable to use the off-chain assets. In the case of a problem with the transactions considering the off-chains assets, it is needed to seek the participation from an outside party or a legal entity. The network effects of the public blockchain will be enormous, and only the time will unfold such an event.

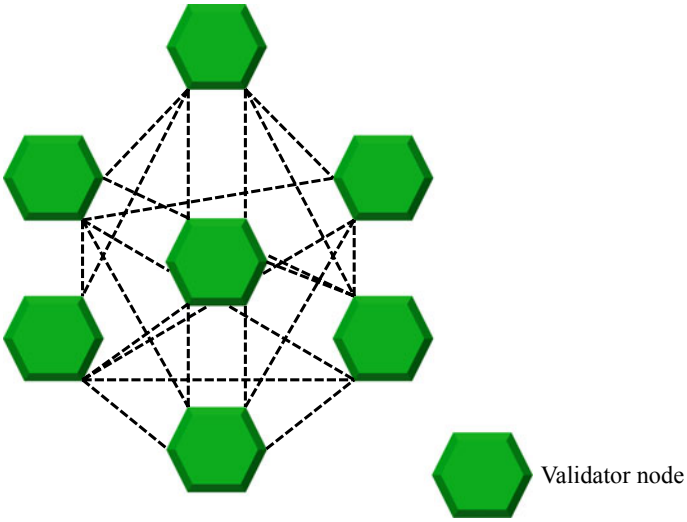

Fig. 4 Public blockchain

Private (Permissioned ledger)

It is also called a permissioned ledger where the nodes have a certain level of controls in the validation process. These nodes are normally preselected to perform a certain level of operations and tasks. Such a network needs participants' invitation and validation to make them the part of the network. For example, a particular financial institution must agree on the transactions to be considered valid.

Similarly, the access rights to read the block in the blockchain can be given to selected participants, for example, government auditors. The adoption of private blockchain enables cheaper transaction cost, increased privacy, and a faster validation process. Banks consider permissioned blockchain to be part of their financial institutions. The network has two types of nodes, one which is responsible for initiating, receiving, and validating transactions and the other one which can only start and receive the transactions. It is in the purview of the organization to design the rules for participation, consensus, and restrictions in the blockchain network. Further, the write permission to the ledger is typically controlled and given to a set of people or organization, and read permission is made public.

Consortium

There are three ways to develop successful blockchains: first, when a single organization builds the network and application; second, when a regulator or a government body enters and develops a controlled blockchain network and application; and third, when a consortium is formed. In a consortium blockchain network, participants preselect a set of nodes by which they can control the consensus process (Zhou et al. 2018). A consortium blockchain provides the features from both the public and private blockchains and is a hybrid model, see Fig. 5.

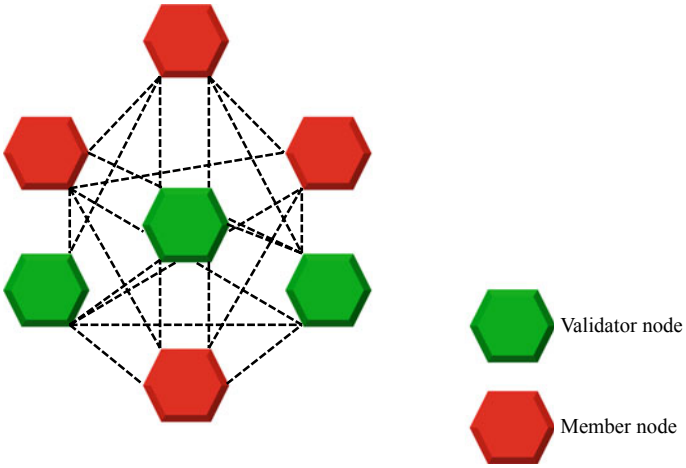

Fig. 5 Illustration of consortium blockchain

The different blockchains have many similarities, but the dissimilarities lie in fact in the way that consensus is established, blockchain network is maintained, and participation is allowed. The participating nodes in the blockchain network are arranged based on peer-to-peer system design and protocol, which facilitates direct interaction of nodes (users) within the blockchain network. The network of nodes is also called peer-to-peer system.

Blockchain Cryptography

Asymmetric cryptography

Blockchain uses asymmetric cryptography to authenticate, verify, and validate the transactions without revealing the identities of the users. Asymmetric cryptography is achieved by the way of using two different keys: public and private keys. Each user maintains secretly the private key, and the public key is available on the blockchain network. The keys are used to work with the messages supporting encryption and decryption functionalities. The public key is used as the sender's address when the sender initiates and broadcasts the transaction message. The message consists typically of two elements: first, the message and the second, the encrypted digital signature of the message mapped to the hash value, which is signed by the private key. The recipient has to create the hash value of the message and then decrypt the message by using the sender's public key. Once both the hash values are in sync, then the transaction is approved. To avoid double-spending in the transaction, blockchain uses user's account transaction history and incentivization process. The transaction is mapped to the hash value, digitally signed, and then the network can tell that the assets belong to the user as the transaction history is available to the public.

Consensus

The consensus is the fundamental aspect of human society. It is one of the specific ways by which diverse group agrees on something without any conflicts. According to Edward Shils' "The Concept of Consensus," to achieve consensus, it is required to have the following three things:

- the participating network should follow the agreed norms including any specific rules and laws;
- allow and agree upon the institutions and organization that governs the norms, laws, rules, and specifications;
- to provide the self-identifiable aspect of recognizing and respecting the members and agree on the equality for achieving the consensus.

Consensus mechanisms have taken a significant role in defining the distributed ledger technology. By the distributed consensus, all nodes in the system can find out the single truth about the ledger by using the identical and chronological transactions (Toshs et al. 2018; Drescher 2017). The consensus in a distributed nature provides the unified and integrated view of the single truth which supports the only single view of the state of the information to the members of the participating network. In the permission-less blockchain, as there is no enforcement of any particular restrictions or constraints, anyone who wants to contribute can join and participate in the network. Anyone can join in the consensus process while the permissioned blockchain place constraint on the select participants to participate in the process. A consensus framework comprises the agreed set of rules, policies, restrictions, and procedures to represent the unified and integrated information to the participants in the network and by design, impose the fault-tolerant behavior. Thus, the failure of a few nodes does not allow one to alter the data, and the correct and original data can be fetched regarding the transactions. The organization can use or build consensus frameworks considering various requirements like the transactions scalability, nature of the effectiveness and network performance, rules and policies to govern the transactions, and protocols for achieving security and privacy.

There exist many varieties of the consensus algorithms, but the usage of the specific consensus mechanism depends upon the underlying blockchain structure, which is available in three different forms—public, private, or consortium. All the blockchain structures lead to a common goal of ensuring to store and maintain the only single, unified, and integrated version of the truth (Castor 2017). The problem of double-spending, which was a severe concern for the transactions of value now can be solved through the blockchain consensus mechanism. By involving incentivization in the whole process to agree on the transaction, the double-spending problem can be solved efficiently (Hua and Notland 2016). There exist varieties of the consensus mechanisms that run on the blockchain platform, but all of them primarily more or less share the same issues. For example, some of the consensus mechanisms draw a considerable amount of the computational power and energy to

agree on the consensus. Some other consensus mechanisms have varying levels of security based on the underlying blockchain network. Let us explore the common consensus mechanisms deployed in the blockchain network.

- Practical Byzantine Fault Tolerance (PBFT)
  In the PBFT, all the nodes in a blockchain network own a public key. Once a message for the transaction is initiated and broadcasted, the nodes run the information in conjunction with the public key to execute the operation. Each node in the network runs the operation as per the transaction information. Once the operation is over, and the individual node has the decision to make, it shares the resolution within the network. The consensus is arrived based on the decisions of all the nodes. In the process of collective consensus, the network engages with the collective decisions of the nodes for all the transactions. Hyperledger uses the PBFT consensus mechanism for the blockchain network.
- Proof of Work (PoW)
  In the PoW, the participating nodes are engaged in high intensive computational and mathematical work to reach the consensus. PoW does not require the participation of all the nodes; instead, it uses a unique hash code of particular size. The node that solves the mathematical puzzle and generates the hash code for the same submits it within the network. Later, the other nodes verify the information and once verified, the block is created, and the blockchain is updated with the new block. The purpose of using hash function is that it cannot be reverse engineered, which means false conclusions are unacceptable and do no contribute to the computing decisions.
  Moreover, the PoW inherently acts as a random process with a low probability of success, which means before any nodes generate the valid proof lots of trial-and-error processes are required. The PoW is used in the Bitcoin, and the node that first submits the valid proof becomes eligible for the reward in terms of few Bitcoins. In PoW-based blockchain, the workload that the network agrees and executes leads to the proportional blockchain length. It signifies that the participating network trusts the single version of truth utilizing the longest chain. Thus, it becomes a strenuous and high complex activity to tamper with the information in the block once it is created and linked in the blockchain. Even, if we assume that one target to cheat the blockchain system, then the participating node needs at least more than 50% control of the network. It will then enable the node to generate the hash code and submit it first within the network.
- Proof of Stake (PoS)
  In the PoS, the participating nodes involved in creating and linking a new block has a more or less financial interest as they get rewards in doing so. The PoS replaces the hash function with the digital signature. The network randomly selects the participating node based on its proportional stake in the network to approve the transaction. This means that the network initiates the lottery system and engages the nodes depending upon the contributory stake in the network. Bitshares, Nxt, and Blackcoin use the PoS. Ethereum is currently planning to

use PoS consensus mechanism with its new update—"Casper" which works on the concept of security deposits and bets to achieve consensus.

- Proof of Importance (PoI)
  In the PoI, the consensus is targeted based on the contribution of the participating node in the network and thus does not depend on the amount of work or the stake. Some of the contributing factors considered by the PoI are reputation, the number of transactions achieved, the number of transactions performed, overall balance, etc. These contributing factors help the network in determining the importance of the node in the network. The higher the importance score of a node, the higher the trust factor associated with it to verify the transactions. The PoI is used first by the NEM in its platform.
- Delegated Proof of Stake (DPoS)
  The initial design of the Bitcoin is the assumption to use the computational power to solve the mathematical puzzle. The participating nodes can generate the hash code, and the nodes get the opportunity to contribute to the decision-making in the blockchain network. Once the node is accepted, the block can be added to the blockchain, and the reward is provided to the respective node contributing the new block. Since such kind of mining requires a huge amount of computational power, particular machines were developed. The consequence of utilizing special machines resulted in restriction in involving the ordinary miner having limited capacity to mine.
  The proof of stake overcomes such problem by addressing the node to respond to the contribution by the way of agreeing on the stake and as such computational power is not required. Such a mechanism is known as delegated proof of stake (DPoS). For example, BitShares utilizes it to validate transactions in the participating network. In the DPoS-based blockchain, the nodes get the voting rights based on their stake value. As long as there exists, 50% of the nodes agreeing on the decentralization of the decision-making and sufficient stake to contribute blocks to the blockchain the DPoS are functional. The participating nodes acting as witnesses based on their stake in the decision-making takes the necessary action to create the block.
- Proof of Authority (PoA)
  In the PoA, the network is relied on the limited number of validators to verify the transactions. It is a reputation-based consensus approach where the preselected validators attempt to validate by leveraging the value of the identities. Therefore, PoA blockchains are scalable and secured as the preselected nodes are considered as trustworthy entities to verify the transactions. Such type of consensus is more appropriate in permissioned and consortium blockchain.
- Proof of Burn (PoB)
  In the PoB, the participating nodes in the network aim to reach the consensus based on the PoW concept but without energy waste. Burning (or destroying) of the coins is the mandatory requirement of the PoB consensus protocol which has to be performed by all the participating nodes. The burning of coins is achieved

when the coins are sent to the unspendable address and cannot be recovered. The nodes then get the rewards to do the same.

- Proof of Capacity (PoC)
  In the PoC, the participating nodes take a voting mechanism for the new blocks based on the capacity of contributing the disk space. The capacity plays a major role in arranging the ledger blocks appropriately which can be retrieved as and when needed.
- Proof of Elapsed Time (PoET)
  In the PoET, a lottery or a random selector model is utilized to select the leader that can perform the validation of the blocks. One of the fundamental concepts is to randomly distribute the leader election among the participating nodes in the network and then by a secure way the participating nodes agree on the election of the leader. Some platform like Intel's has a specific mechanism to approach the PoET. The validator has to perform the computation of code in a certain period, and the one which has the shortest wait time wins the lottery and elected as the leader and creates a block.
- Alternatives: There exist some other consensus mechanisms based on the PoS. All such PoS alternatives require validators to hold and prove the ownership of the coins
  - Proof of deposit: In PoD, the validators have to deposit a certain amount of coins, which cannot be used during the process, to participate in the validation process. In Tendermint, the PoD is applied where the validators have the right to mine the blocks based on the voting power, which is proportional to the number of coins deposited in the network.
  - Proof of burn: It requires miners to burn a portion of their coins. Normally, these coins are assigned to the unapproachable and unspendable address, which cannot be utilized for any transactions.
  - Proof of coinage: In the PoCA, the miners agree on the validation process based on the age of the coins possed by the miners. For example, the validators who have the maximum quantity of the coinage coins become the leader.

Development in Blockchain Platforms

There exist two main areas where a blockchain is utilized: one is to build the distributed applications (DApps) and second is to optimize the infrastructure. As more and more DApps are getting developed on the existing platforms, the need for incumbents to build infrastructure is less. Moreover, there are no existing standards for the platforms, and many different ledgers are available in the market. The difference lies in the type of blockchain architecture (permissioned, permission-less,

consortium) and the consensus mechanisms deployed in it. In some cases, the organizations want to control the rights of reading, writing, and validating the transaction process and thus focus on the permissioned and consortium architecture.

Four Emerging Segments for Blockchain Applications

Blockchain provides a new computing paradigm to facilitate the development of DApps. There exist four types of segments that run business used for the blockchain, see Fig. 6:

Currency-use case:

The DApps will target the transactions related to money transfers, payments, tips, fines, fees, etc., in various domains. The users engaged in utilizing the services will directly involve the parties without considering the intermediaries. Suck kind of applications will help the users to get the cost reductions, fast and effective processes, quick settlements, and freedom from the central intermediaries.

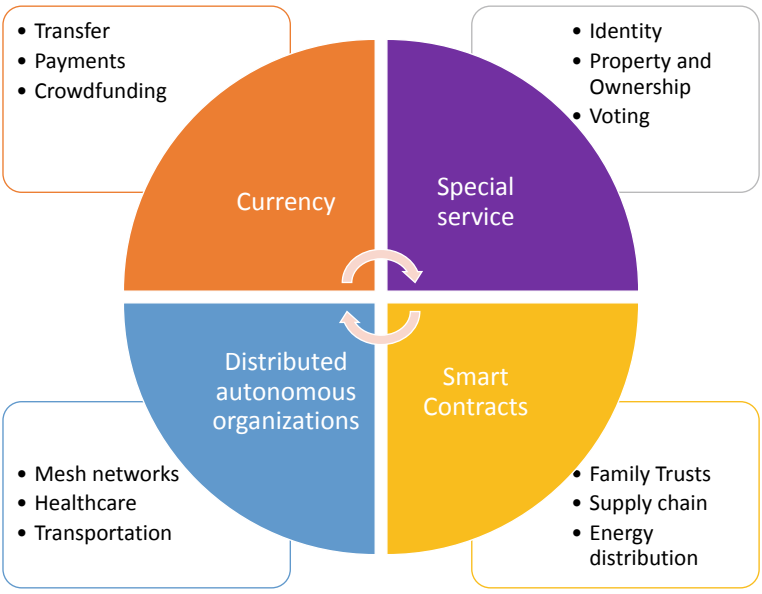

Fig. 6 Emerging segments for blockchain application

Special service use case:

The DApps in this category deals with the atomic unit of the blockchain network, such as storing the value. The services will offer the storage of the identity and impact several different verticals. For example, the creative industry will have the digital identity of its creation, and the DApps provide services such as user can check the provenance of the artistic artifacts, and then later decides on the licensing or royalty aspects of the use of the artifacts. Blockchain can be used to store the digital identities of individuals, organizations, assets, titles, voting rights, and mostly everything that can be represented digitally.

Smart contracts use case:

The smart contracts are the critical component of the DApps. It helps in a self-executing portion of statements (codes) as agreed by the participating parties. Each smart contract can be entrusted by the unit of value—token or coin. Thus, no one has to wait longer for the settlements. The smart contracts are used to programmatically map the contractual governance which can be verified and self-executed (as per the conditions and events) on the blockchain network without the need of any central authority. Blockchain can execute peer-to-peer transactions without trusted third-party intermediaries, reducing clearing and settlement times and related costs.

Distributed autonomous organization (DAO) use case:

In the DAO, the participating parties configure itself on the blockchain network in such a way that the value appreciation of the network is evident by their contributions.

Concluding Remarks

Blockchain is still a nascent technology, and businesses are unaware of the business use cases, technology know-how, and business opportunities. In the blockchain network, the blockchain users run the same software on their computer to form a decentralized and distributed network where users can perform transactions, trade assets, and other entities of value. Blockchain is now treated as the first internet-scaled open platform for value exchange. Distributed consensus secure that everyone has the same truth; what I see is the same as what you see. There exist many varieties of the consensus algorithms, but the usage depends upon the architecture of the blockchain—public, private, or consortium. There exist two main areas where a blockchain is utilized: one is to build the distributed applications (DApps) and second is to optimize the infrastructure.

References

Avital, M. (2018). Peer review: Toward a blockchain-enabled market-based ecosystem. *Communications of the Association for Information Systems, 42*(1), 646–653.

Castor, A. (2017). *A (Short) guide to blockchain consensus protocols*. Retrieved April 5, 2019, from https://www.coindesk.com/short-guide-blockchain-consensus-protocols.

Drescher, D. (2017). *Blockchain Basics A Non-Technical Introduction in 25 Steps*. Springer.

Hua, A. V. & Notland, J. S. (2016). Blockchain enabled trust & transparency in supply chains ntnu school of entrepreneurship tiø4530 (Autumn, 2016).

Mattila, J. (2016). The Blockchain Phenomenon—The Disruptive Potential of Distributed Consensus Architectures. Berkekey Roundtable on the International Economy.

Melanie, S. (2015). *Blockchain: Blueprint for a new economy*.

Nakamoto, S. (2008). *Bitcoin: A peer-to-peer electronic cash system*. Retrieved April 13, 2019, from https://bitcoin.org/bitcoin.pdf.

Rizzo, P. (2016). Consulting Firms Face Talent Shortage As Blockchain Offerings Grow. CoinDesk. Retrieved from http://www.coindesk.com/consulting-firms-hiring-blockchain-talent/.

Tosh, D. K., Shetty, S., Liang, X., Kamhoua, C., & Njilla, L. (2018). *Consensus protocols for blockchain-based data provenance: Challenges and opportunities*. Paper presented at the 2017 IEEE 8th Annual Ubiquitous Computing, Electronics and Mobile Communication Conference, UEMCON 2017, 2018-January pp. 469–474.

Yli-Huumo, J., Ko, D., Choi, S., Park, S., & Smolander, K. (2016). Where is current research on blockchain technology?—A systematic review. *PLoS ONE*, *11*(10).

Zheng, Z., Xie, S., Dai, H., Chen, X., & Wang, H. (2017). An overview of blockchain technology: Architecture, consensus, and future trends. In *2017 IEEE International Congress on Big Data (BigData Congress)*.

Zhou, L., Wang, G., Cui, T., & Xing, X. (2018). *Cssp: The consortium blockchain model for improving the trustworthiness of network software services*. Paper presented at the Proceedings —15th IEEE International Symposium on Parallel and Distributed Processing with Applications and 16th IEEE International Conference on Ubiquitous Computing and Communications, ISPA/IUCC 2017, pp. 101–107.

Chapter 3
Messy

Ideally, the two structures—hierarchy, and relationship structure wrap around each other to ensure responsibility, to keep information flow and the creation of power.

—Pearl Zhu, Digital Maturity: Take a Journey of a Thousand Miles from Functioning to Delight

I am wary of the whole dreary deadening structured mess that we have built into such a glittering top-heavy structure that there is nothing left to see but the glitter, and the brute routines of maintaining it.

—John D. MacDonald, The Deep Blue Good-By

Abstract Applicability of blockchain is massive in business contexts, but the value comes through addressing the two core elements—technology and management of the blockchain. In this chapter, readers will get to know the impeccable capability of the blockchain to reduce messiness—transaction and agency costs—and to manage applications portfolios.

Introduction

Firms need to be redesigned in the modern capitalist era and discover its boundaries to serve and participate in the global market for identity management and peer-to-peer transactions. Perhaps, the starting point is to develop the problem statement with the defined business use case. Noble Laureate Economist Ronald Coase proposed three important transaction costs (Coase 1937). He argued that the Firm would expand until the transaction cost of production inside the Firm is less than the outside.

There are various options available for the organizations to deal with the blockchain wave:

- Build in-house capability,
- Outsource activities,
- Co-partner,

N. Upadhyay, *UnBlock the Blockchain*,
https://doi.org/10.1007/978-981-15-0177-7_3

– Co-collaborate,
– Merger and acquisition,
– Native company, and
– Rebuild.

To redefine the Firms, we also need to work with the type of transaction costs such as cost of search, cost of the contract, cost of coordination, and cost of trust, see Fig. 1. Searching the right people, resources, infrastructures, places, etc., to create and develop meaningful and profitable value involves huge search cost. The Internet era helped in lowering the search cost to a greater extent. The availability of excellent search engines, useful browsers, usable search filters and queries, access to vast information pool, digital infrastructure, etc., contributed to the lowering of the search costs. The other transaction cost is the cost of coordination, which is associated with the efforts needed to coordinate the resources, people, process, and infrastructures to deliver the value. However, the Internet has lowered coordination costs by making available coordination tools such as Email, Digital Whiteboards, SharePoint, CRM, MMS, Social Media, etc. The cost of contracting involves identifying the contracting terms, conditions, and policies among agents, labor and materials, and the third party; keeping trade secrets; and tracking, controlling, monitoring, and enforcing policies (Weber 2017). The outsourcing model has lowered the cost of the contract.

There exist many differences in the way that the search in the blockchain is different from the search performed over the traditional Internet. In the blockchain network, the privacy is preserved with the added dimension of the time, which in turn results in the information of the higher value. The Internet has limited influence

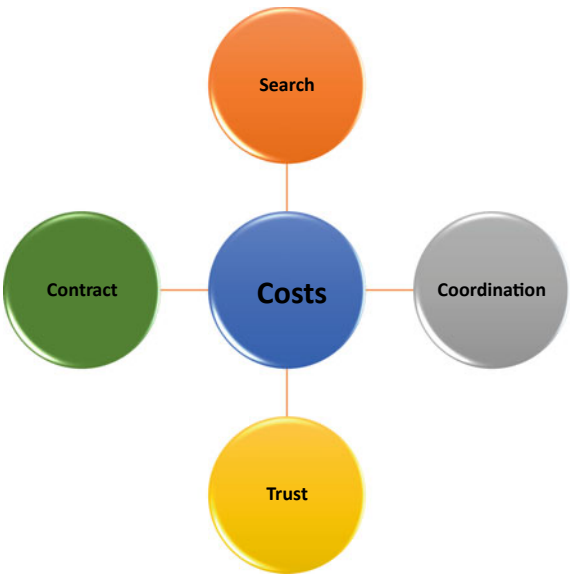

Fig. 1 Transaction costs

on corporate architecture. The Internet, however, has limited impact on the company's hierarchy. We could see that the prevalent structure is still hierarchical, having a leader at the top controlling the decision authority followed by different levels of leadership, though, in yesteryears, the standards of the hierarchy have little flattened or meshed depending upon the goal and the vision of the organization. The decision-makers and the leaders are within the boundary of the company. The decision-makers and the managers still look at the hierarchy as a boundary and consider it as a useful model to manage and maintain resources, projects, assets, and intellectual capital. The blockchain platform holds the promise to redesign the organization's structure into the network of collaboration, participation, openness, trustworthiness, and values. Moreover, it helps in further reducing the transaction costs. The blockchain platforms ensure the protection of user identity, respecting user rights, ensuring network security, and establishing trusts.

Cost of Search

Now, we will look at the blockchain's transaction cost in searching the information, goods, and services. Companies like P&G, Goldcorp, and other Conglomerate started using open market space for valuable participation to connect, collaborate, share, and develop ideas, services, and products. The Goldcorp was in the gold mining business, and they had the problem to find the next effective location to perform gold mining operations. Mining in a wrong location not only consumes time and efforts but also results in delays and huge costs. They organized the open gold contest and shared their geospatial data about gold mining. Many teams participated in the contest, and the solution submitted by the winner team helped the Goldcorp to increase their gold mining value by 100%. The blockchain is another "big bang" in the innovation landscape, and business leader needs to understand the worldwide [distributed] ledger. The search engine on the blockchain will provide enormous innovative insights about products, services, market, entities, and anything that you need deem fit for your business. The blockchain ledger contains the chronological transactions history, and thus it is then possible to retrieve valuable information, for example, relevant list of suppliers and then rate them as per their services and ability to deliver the goods and raw materials.

Blockchain search will have a distinct and unique character as compared to the Internet search. First, the way that privacy is handled. User has a right to the anonymity level, and the search could be performed on the information revealed on the ledger. The search query could be the combination of various filters and if/else or yes/no hierarchical structure to deal with the right and precise information. Such kind of search will remove the middle party that is involved in providing the search services, for example, "resource search." Organizations like Headhunters and Executive search will no longer function the same way as the transaction cost for the search is lowered and more managed by the blockchain search. For example, job seekers will be empowered to choose the company, and the company will also

be in the correct state to deal with the "right fit." However, the transaction cost will also be influenced by the way the search query and filters are used. In some instances, the stripped and precise questions will give accurate results and thus put the cap on the "profile zone." Moreover, few actors will emerge to perform the deep query on behalf of the companies. In another case, when people restrict themselves in providing full information on the ledger, then it may also lead to the possibility of getting excluded in the "profile zone."

In addition to the Internet search, the blockchain search is multidimensional and has an added dimension of time (chronological sequence). It is helpful to the searchers to view the complete transaction history of any entity, whether it is companies' bad or good decision or any particular events of interest. Another change is in the inherent "Value." The blockchain involves lower transaction costs for the value exchange. The business and competitors will hold more valid and trustworthy information and can create valuable products and services. For example, ConsenSys a native blockchain company is disrupting the identity space by allowing participants to hold their data, choose the way they want it to be used, create and control personal avatars, connect with other participants, and most importantly monetize it (by getting rewards). Such a fantastic concept is a threat to the existing business model like LinkedIn.

The sharing economy is giving rise to the decentralized business. However, these models are constrained due to the involvement of the large pool of aggregator with limited and unequal distribution of the [shared] value where still giant aggregators control the information and systems. The democratization of the value exchange will be possible by the use of the blockchain in sharing economy businesses, as it will remove the centralized aggregators.

Cost of Contract

Another way by which blockchain can lower the cost of the transaction is through the cost of the contract. Contracts are the critical artifacts that deal with aspects of establishing, firming, agreeing, and enforcing terms conditions policies and actions. Currently, companies have to hire employees (permanent/short term) to do certain kind of work and thus require legal and expert advice; strategizing, drafting and enforcing terms, conditions, and policies applicable in the work/business environment, etc. But with blockchain, it is possible to lower the contract cost by including smart contracts. By bringing contract cost to zero, companies can move to the open market to connect, collaborate, share, and deliver values. The human society, by far from its existence, has served and enforced societal contracts. There exist consequences to the contracts in case the contracts are not spelled out precisely and not in the purview of a legal framework.

The purpose of the contracts is to establish rights for the parties as per their agreement. These rights can vary depending on the jurisdiction and the enforcement actions (for example, compensation or rework, etc.). Oliver argued that Firms exist

to resolve the conflicts. Moreover, Economists like Jensen and Mackling (1976) argued that the corporate entities are just the collection of contracts and relationships and nothing else. The decision body in the organization can craft and enforce the contracts by utilizing the smart contracts on the blockchain platform, thereby achieving a reduction in the cost of contracts.

Cost of Coordination

Once the search is over and you have agreed on the terms and conditions, then another battle is to tackle the coordination aspect to achieve the desired outcomes. This is not easy and incurs huge costs, which involve the cost of establishing synergy among the actors, aligning them with the processes and other enterprise artifacts to deliver the value. Noble Laureate Williamson suggested two coordinated systems—market and hierarchy. The market system represents the pricing system by which resources can be allocated in a decentralized way. While the hierarchy system allocates resources as per the central authority, Ronald Coase disagreed to the earlier economist views of considering the internal market in the enterprise. Moreover, Coase suggested that department change of individual from X to Y does not depend on the market dynamics (for example, change in relative pricing) but is the result of the change order.

The agency cost theory suggests that the cost is associated with making the actors inside the firms acting in the owner's interest. Nobel Laureate Joseph Stiglitz argued that due to the Firms size and complexity, agency costs of the organization have increased even though there is evidence of lower transaction costs. In the blockchain network, the agency space will be mapped seamlessly but with the change in the structure and design. The agency tasks—principal to control agents—will be distributed in the blockchain network. Blockchain offers a reduction in the agency cost—the cost of supervising agents—by establishing the trust in the relationships between the principal and the agents, which is created through self-executed contracts. Further, the integrity of contractual relationships between the principal and the agent is achieved through the presence of the immutable and cryptographic security system. Such a system eliminates the agency costs for monitoring and enforcing the contracts, which in the blockchain network will be executed automatically when the participating parties fulfill the contractual agreements. Table 1 summarizes the reduction of agency costs through blockchain.

Moreover, the integrity of the principal is secured as the blockchain network does not allow any fraudulent transactions. Besides, the cryptographic system triggers the removal of the trust barriers, which affects the agency relationships and avoids the agency costs for monitoring the agents. Smart contracts enable to achieve the zero agency cost in coordinating the agency relationships.

Blockchain will remove the intermediaries and redefine the governance structures facilitated by the agents. The establishment of the first decentralized autonomous organization (DAO), launched in 2016, challenges the necessity of the

Table 1 Agency costs' reduction

Agency costs	Description
Supervising	The self-executed code through the smart contracts manages the trust in the relationships between principal and the agents
Monitoring	The integrity of the principal is secured as the blockchain network does not allow any fraudulent transactions and the blockchain network executes the smart contracts automatically when the participating parties fulfill the contractual agreements
Contracts	The integrity of contractual relationships between the principal and the agent is achieved through the presence of the immutable and cryptographic security system

governance structure in agency. While the first DAO was shut down due to the backlash from the community in response to the flaw in the code which helped hacker to seize a large amount of money, it is expected that the future DAOs will overcome the limitations and eliminate the agency costs by redefining the agency relationships (Fehrer et al. 2018).

Blockchain will help in reducing agency costs by incorporating smart contracts, openness, transparency, and trustworthiness. All the stakeholders can view the single version of the truth in the blockchain. The managers are the intermediaries between the owners and the workers, and they need to rethink their role in the blockchain era.

Cost of Trust

It is easy to build trust with the boundaries rather than outside the boundaries. Look at the way that we trust our family members. The level of trust is different from the outside world. For example, the way that we perform, act, behave, connect, and share within the family is way different from others (outside the family). Maintaining trust can become not only expensive but also inefficient and complicated in the increased globalization and digitization of businesses. So, what is that needed to establish the trust outside the boundaries? Grandison and Sloman (2000) suggest the five different classifications of trust for the online space. These are classified as provision trust, resource access trust, delegation trust, certification trust, and infrastructure trust (Jøsang et al. 2007). Table 2 shows a summary of the trusts.

Both the protocol layer and the business layer affect the trust in the blockchain network. In the protocol layer, the trust is established by the transparency and security. The transparency is achieved by the presence of public–private keys and immutable chronological sequence of transactions history. Moreover, it is easy to identify the change in the record, when it is done? and who has done? Further, the security is enhanced by the built-in encryption feature in the blockchain network.

Table 2 Trust types in the online space

Trust type	Description
(Service) Provision trust	The participating party trusts the service provisioned for use
(Resource) Access trust	The participating party trusts the rules for resource access and utilization
Delegation trust	The participating party trusts the agent (or the third party) that takes decision or action on behalf of the participating party
Certification trust	The participating party trusts the identity and authenticity of the trusted party
Infrastructure trust	The participating party trusts the infrastructure

Further, the business layer also contributes to establishing the truth by enforcing use case specific rules. For example, it is understood that by using Bitcoin, one can ensure the correctness in the accounts. Aljazzaf et al. (2010) suggested that the information give rise to the trust and the more the information, the stronger the trust. As blockchain stores historical transactions in sequence, it generates more information about the event or an entity, and such information is useful to increase the trust.

The trust is programmable and hardwired in the blockchain network. The immutability aspect of the blockchain's platform makes it a viable choice to establish the reliability of the information and the data by achieving reduce chances of fraud, thus gaining trust. The cost of building trust is zero, and the financial system or other parties need not engage in the hard efforts of trust identification and establishment. For example, there is no need to maintain a third party or any intermediary as the parties involved in the transaction need not keep a separate record of transactions, and only one truth prevails. The smart contracts will make parties accountable. Blockchain establishes transparency, and with the help of smart contracts, participants can achieve integrity. As suggested by Economist Michael Jensen and his colleagues that integrity is the factor of production, it is not uncommon to attain a high level of output through blockchain that supports integrity and trust. Leveraging on the blockchain network, Firms can go beyond the boundaries and deal directly with the outside actors without the intermediaries.

Lakhani and Iansiti (2017) suggested that the adoption of the technology depends on two main attributes: first, the novelty which means the more the novelty, the more the effort required to adopt the technology; and second is the complexity which refers to the value ecosystem involved to deliver the value out of the technology. It includes coordination efforts, participating parties' involvement, etc. Further, they proposed four-quadrant-based framework that maps the innovations with the two attributes—novelty and complexity. The four quadrants and the major drivers for lowering the transaction costs, see Fig. 2, are as follows:

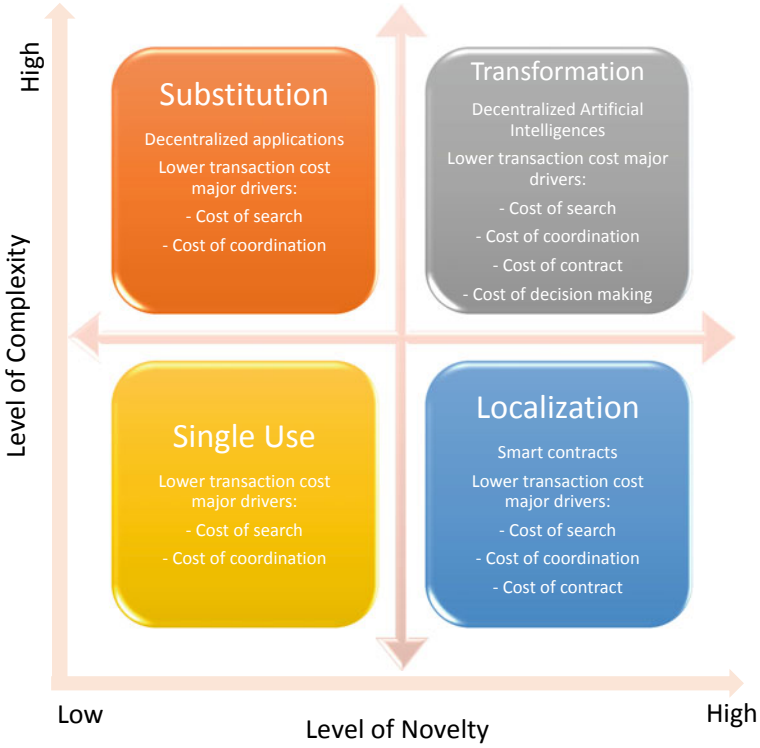

Fig. 2 Technology adoption framework and lowering transaction cost drivers

Single Use

It is the single use case quadrant; the technology is initially utilized to develop a single application. For example, when Email was developed in the early 1990s instantly, it became famous and worldwide got appreciation. The single-use application is less novel; usually, do not require coordination activities of several players and is less complicated. Considering the case of blockchain, when Bitcoin was introduced as a single use case as an alternative payment method immediately, its usage surpassed the expectations. The significant drivers for lowering the transactions costs involve the cost of the search.

Localization

In this quadrant, the novelty is high due to the inherent implications of the extended usage. For example, the formation of Email networks or Internet corporates to support the broader outlook of the Email. Similarly, blockchain single use case network will outgrow to facilitate broader perspectives. It requires modest coordination to achieve functionality. The significant drivers for lowering the transactions costs involve the cost of search and the cost of coordination. However,

specific applications still plan to use smart contract for the functionality and thus get affected by the cost of contract.

Substitution
In this quadrant, the number of applications will outgrow based on the single use case and localized applications. For example, Bitcoin can be used to buy products and services from Amazon, MakeMyTrip, etc. There will be an increase in substitutes like other cryptocurrencies—Litecoin, Ether, etc. Multiplayer coordination is required to support such initiatives. Consumers can witness a plethora of applications in different domains. The significant drivers for lowering the transactions costs involve the cost of search and the cost of coordination. However, specific applications still plan to use smart contract for the functionality and thus get affected by the cost of the contract. Moreover, decentralized applications will proliferate.

Transformation
In this quadrant, the implications of the applications are enormous to the social, economic, and political system. Applications inherently will start using smart contracts, autonomous agents, and intelligent agents to drive the value system. The significant drivers for lowering the transactions costs involve the cost of search, cost of coordination, cost of the contract, and cost of decision-making. The inclusion of artificial intelligence will enable involvement of the autonomous agents to take the decisions.

Concluding Remarks

Firms need to be redesigned in the modern capitalist era and discover its boundaries to serve and participate in the global market for identity management and peer-to-peer transactions. To redefine the Firms, we need to work with the type of transaction costs such as cost of search, cost of the contract, cost of coordination, and cost of trust. Both the protocol layer and the business layer affect the trust in the blockchain network. Blockchain technology adoption framework is useful to strategize the application portfolios.

References

Aljazzaf, Z. M., Perry, M., & Capretz, M. A. (2010). Online trust: Definition and principles. In *2010 Fifth International Multi-conference on Computing in the Global Information Technology (ICCGI)* (pp. 163–168). IEEE.

Coase, R. H. (1937). The nature of the Firm. *Economica*.

Fehrer, J. A., Benoit, S., Aksoy, L., Baker, T. L., Bell, S. J., Brodie, R. J., et al. (2018). Future scenarios of the collaborative economy: Centrally orchestrated, social bubbles or decentralized autonomous? *Journal of Service Management, 29*(5), 859–882.

Grandison, T., & Sloman, M. (2000). A Survey of trust in internet applications. *IEEE Communications Surveys & Tutorials*, *3*(4):2–16.

Iansiti, M., & Lakhani, K. R. (2017). The truth about blockchain. *Harvard Management Review*.

Jensen, M., & Meckling, W. (1976). Theory of the firm: Managerial behavior, agency cost, and ownership structure. *Journal of Financial Economics, 3,* 305–360.

Jøsang, A., Ismail, R., & Boyd, C. (2007). A survey of trust and reputation systems for online service provision. *Decision Support Systems, 43,* 618–644.

Weber, R. H. (2017). Blockchain as a legal challenge. Jusletter IT, (May) Retrieved from www.scopus.com.

Chapter 4
Business Models

Nobody thought the direct business model would work. But work it did, and spectacularly. Until it didn't. And therein lies the tale.

—Heather Simmons, Reinventing Dell

By digitizing a traditionally analog business model or process, we're effectively turning it into bits and atoms and enabling an infinite variety of possibilities.

—Nicholas D. Evans, Mastering Digital Business: How powerful combinations of disruptive technologies are enabling the next wave of digital transformation

Abstract The Internet has created new possibilities that we did not foresee in its early years. Blockchain technology is unique and has great potential to penetrate existing markets and to develop new markets. In this chapter, readers will understand business models for blockchain technology. It will help them to know how a current business can be transformed and also how to create new markets.

Introduction

In recent years, both the industry practitioners and academic scholars have taken a great interest in the business models (Zott et al. 2011; Wirtz et al. 2016; Osterwalder et al. 2005; Dasilva and Trkman 2014). It is better to treat business model and strategy separately as the strategy targets the long-term consequences, which mean strategy can guide the industry to develop capabilities that lead to a change in the business model. For example, the strategy to include transformational ability like change from manual process to the automation process transforms the business model, this business model does not cater to the need of the strategic insight but instead "*it paints a picture of the company and reveals how the various elements of the business work together at a certain moment in time*" (Dasilva and Trkman 2014, p. 386). Osterwalder also distinguishes business models from strategy (Osterwalder 2004; Osterwalder et al. 2005). In this definition, Osterwalder (2004) in his work distinguishes the business model from the strategy and define the

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elements of business model to cover—what cost and revenue infrastructure is available for the industry; what value proposition is offered to the customers; what channels are used to deliver products and services and the value; what key activities and target are necessary; and what partners are involved.

Businesses have to discover and navigate the business opportunities to unleash the potential of the blockchain. More importantly, they need to identify the factors that affect the blockchain implementation and in turn, affect the business model. To capture the real value of the blockchain, we need to understand the business model environment. The business model does not run in isolation and is affected by the business model environment. There exist four critical factors that influence the business model of organizations. These factors categorized into key trends, macroeconomic forces, market forces, and industry forces Osterwalder et al. (2010), see Fig. 1.

Key Trends

It helps the industry to be abreast with not only with the latest technology and factors but also to get aware of the potential future technologies and factors that could affect the business. A foresight analysis help organizations to understand and discover essential patterns that could affect their current business models; for example, key trends may enhance or threaten current business models. For each

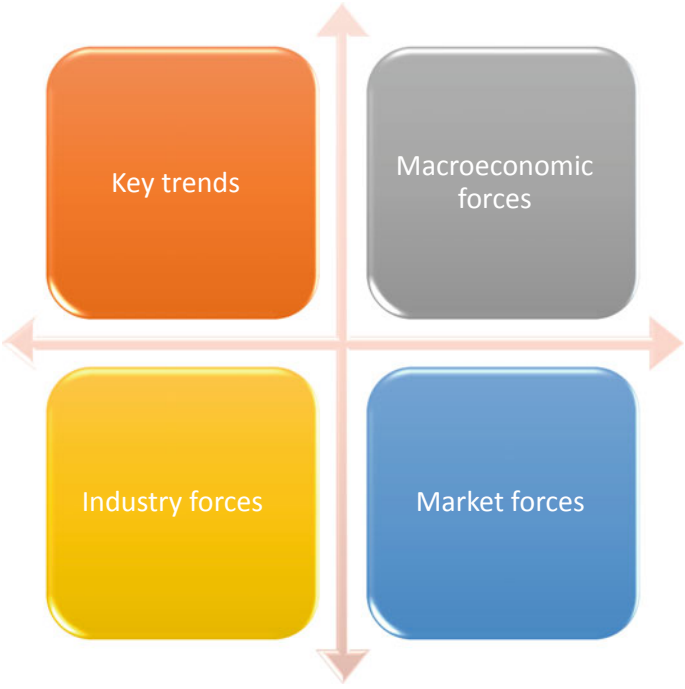

Fig. 1 Business model environment forces

company, the requirement to perform key trends analysis will be different, and scanning for significant trends such as technologies, regulatory policies, guidelines and frameworks, societal and cultural, and socioeconomic changes that could affect the business model is pertinent. The inter- and intra-technology setup and capability analysis help organizations to understand the disruptive effects and thus provide details of whether to continue, discard, change, or customize the current technological structure and capability or to adopt and embrace the new technological landscape.

Further, regulatory changes in policies, guidelines, and protocols might throw constraint on the design of the business model, which can restrict the playground for the business elements. The scanning and knowledge of the critical trends might affect the adoption and deployment of the necessary infrastructure and resources. For example, consider a drug delivery system in the pharmaceutical industry, and if one decides to deliver personalized drugs then it has to develop the resource capability, technological infrastructure, and adaptive cost structure and map with the customer experience and satisfaction. Now, if we consider the adoption of blockchain technology, we can notice that the regulatory body places a massive role in the success of the business model. The industry cannot just adopt and implement the blockchain technology as it might get backfired due to the restricted business execution imposed by the constraint in the implementation of business use cases as per the regulatory framework. For example, Bitcoin is completely banned in countries like Bangladesh, Vietnam, and Iceland, so any company wishes to execute Bitcoin-based blockchain services in these countries will get a backlash and immediate shutdown. Moreover, countries like China have forbidden their financial institutions from the digital currencies, and some parts of European countries have rejected the use of Bitcoin. Indeed, it is necessary to understand and address the regulatory requirements before undertaking blockchain projects.

Recently, due to the surge in the flow of data, stakeholders interests, business opportunities, and broader landscape of the technology, principles like crowdfunding might lead to the threat in the security laws. Moreover, the two current trends regarding security are privacy and information security both in personal and commercial settings that have implications for the business model. However, some regulatory bodies are supporting privacy protection, considering it as a fundamental right by giving exclusive right of the data, while other organizations are promoting information openness where information is treated as a type of public good and thus non-excludable (Pila and Torremans 2016). In both the point of views, a balance is needed to perform the necessary business transactions. However, considering blockchain for the business, few concerns like decentralization and distribution of the information which is transparent and traceable brings implications to the privacy (Crosby et al. 2016). The new GDPR (General Data Protection Regulation) will impose tight constraints for the blockchain business players in the European Union as the GDPR deals with regulation of privacy and data protection to everybody within the union (European Commission 2016). Moreover, in EU the PSD2 (Revised Payment Service Directive) favors the blockchain ability to gather the

information and, roll in eliminating the monopoly of banks on the payment services and account information of customers (European Commission 2015).

One can notice that changes in the socioeconomic trends of the business environment, such as urbanization that supports better governance and involvement, might help the implementation of the blockchain technology considering its distributed and decentralized nature (Marsal-Llacuna 2018). Another trend of interest would be the sharing economy (Sun et al. 2016), where blockchain can provide immense growth potential to support transparent, open, distributed, secure, and trust-free platform.

Macroeconomic Forces

These forces enable the business to understand the global landscape about global market changes, global market dynamics, access to resources, current conditions of the economy, cost and prices related to organization's specific business models and changes in the economic infrastructures and resources (Osterwalder et al. 2010). Macroeconomic forces affect the business model within the business environment and organization needs to devise, formulate, and execute the strategies appropriately to keep the balance in case of a change in the macroeconomic forces. Consider the effect of running a business in different regions of different countries. Each country-specific area might have a diverse economic infrastructure and resource capability, for example, corporate tax structure and availability of resource pool, and thus provide a constraint on the business model to trigger the interplay of the business elements. Moreover, the trend in the capital market like crowdfunding, considering peer-to-peer fundraising and micro-fundraising models (Swan 2015, p. 12), could be the enablers for the adoption of the blockchain technology as it is not restricted to the venture capitalist zones. Such new fundraising models support the creation of the digital currency called tokens which could be sold to the investors as "digital shares."

Industry Forces

These forces focus on evaluating the strength and weakness of the organization to sustain and survive in the market. It helps in understanding and discovering the competitors, new entrants, entry barriers, substitute products, stakeholders, and value chain. Investigation on these forces might throw light on changing and customizing the value chain, for example, a pharmaceutical company may include insurance providers, doctors, laboratory personnel, practitioners, health consultants, healthcare professional, and managers in their value chain. The provenance of the drug over its entire value chain can be verified and authenticated by the inclusion of the blockchain technology which benefits the industry to develop its competitiveness in providing original and good quality drugs.

Market Forces

These forces deal with the inter- and intra-elements such as market segments, market potential, market dynamics, market topology, market network, etc., of the markets. A thorough market analysis is necessary to investigate and identify the information about the customers, incumbents, supplement, substitute and

complement products, revenue resources and infrastructures, entry barriers, switching costs, market segments, etc. Perhaps any change in the elements affects the business model, for example, market topology and market network will be changed in case the business allows the peer-to-peer transaction of values. Company like eBay where now the centralized trusted party that verify and authenticate the transaction will face a new fire from the peer-to-peer business model. Adoption of the technology supporting such transaction will impact the business model of the organization, for example, key partners, distribution and engagement channels, cost and revenue structure, resources, etc.

Business Model Innovation

Blockchain surmounted by its decentralized and transparent structure to support transactions of values might be affected by and contribute to the business environment forces from macro- to microscopic view. The organization thus need to understand both the inside–outside and outside–inside views as it helps in finding out the implications in the business environment and business models (McKinsey 2015; Swan 2015). Further, a continuous investigation of the business model concerning the business environment is necessary. The business model can be defined as something that "[…] describes the rationale of how an organization creates, delivers, and captures value" (Osterwalder et al. 2010, p. 14). In the works of Osterwalder et al. (2005, p. 10), it is stated that "the business model can be seen as the conceptual link between strategy, business organization, and systems."

Further, Osterwalder et al. (2010) describe nine elements of the business model, termed as business model canvas, that help organizations to capture, describe, visualize, assess, and change their business models. Osterwalder's definition of business models is influenced by Kaplan and Norton (1992) and the work that leads to the balanced scorecard approach (Osterwalder 2004; Keane et al. 2018). His business model concept has four dimensions (Fig. 2): Product: What industry does the business operate in, and what is their value proposition to the market?; Customer interface: Who are the customers, how do they deliver value to them and build and maintain a relationship with them?; Infrastructure management: What infrastructure is needed to provide value to its customers?; Financial aspects: What are the costs related to the business and how will it price its products or services to attain revenue? The four dimensions are further divided into nine subcategories of interrelated building blocks affecting a business model (Table 1).

These nine building blocks have further structured to form a business model canvas (Osterwalder et al. 2010), Fig. 3.

Customer Segments

The customers are the ones who decide the faith in the survival and competition of the company. Organizations are investing a lot in understanding the relevant customer segments as they can make or break the company brand and product/service

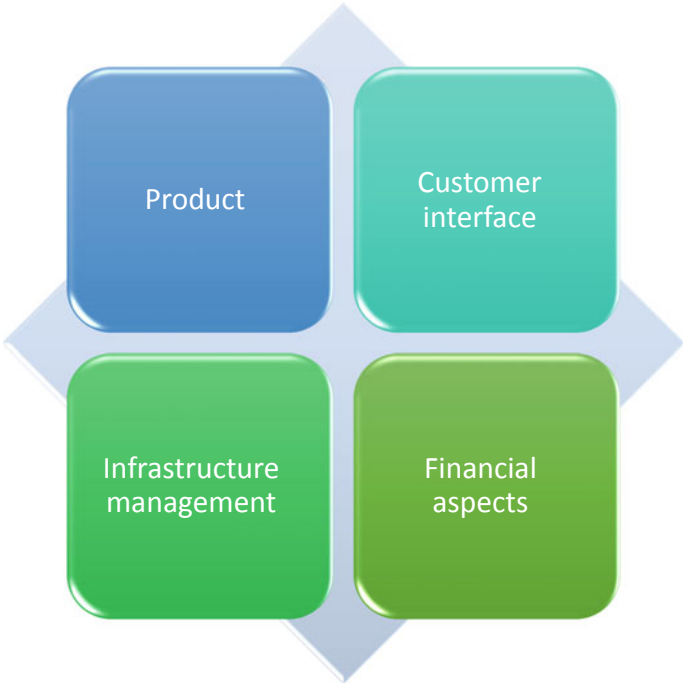

Fig. 2 Four dimensions

portfolio. As described by Osterwalder et al. (2010, p. 20), the "customers comprise the heart of any business model" and thus critical to the success of the organizations. Considering the blockchain technology, it can be seen that the customer-to-customer transactions will be materialized which will remove the involvement of any intermediaries. Further, the use of smart contracts will ease the process. Moreover, to achieve the personalized experience, customer segments will be affected by the use of micropayments and personalized offers. The organization will begin to strategize lower quantities of the product rather than rolling out large quantities to achieve economies of scale (Nowiński and Kozma 2017; Swan 2015).

Value Propositions

The value propositions element refers to the value provided by the product or service (of the company) to the customer segments. By this element, the customer will be able to distinguish the quality and experience of one company's product or service from its competitor's. The value delivered to the customer can represent quantitative attributes like price, speed of service, etc., or qualitative like a specific design, customer experience, etc. Value of the product or service can be produced by introducing unique features (or added features) or by introducing completely disruptive elements. There will be a significant effect on the value proposition by introducing the blockchain, for example, the delivery of the value will be

Table 1 Business model canvas building blocks (Osterwalder et al. 2010; Osterwalder 2004)

Dimension	A building block in business model canvas	Description
Product	Value proposition	What problems, pains, and needs to be are of concerned to the customers and then provide the solutions accordingly?
Customer interface	Customer segments	Who are the potential customers and are there any specific category?
	Channels	How the communication is established with the customers? What are the channels for effective communication?
	Customer relationships	What kind of relationships exists with the customer?
Infrastructure management	Key activities	What activities are necessary to offer value proposition, earn revenues, and reach markets
	Key resources	What resources are essential to offer products or services?
	Key partners	Which collaborations are necessary to enrich value proposition?
Financial aspects	Cost Structure	What costs are involved to deal with the business models infrastructure, activities, recourses, and customer relationship?
	Revenue streams	What are the revenue streams by which customer is willing to pay for the product and services?

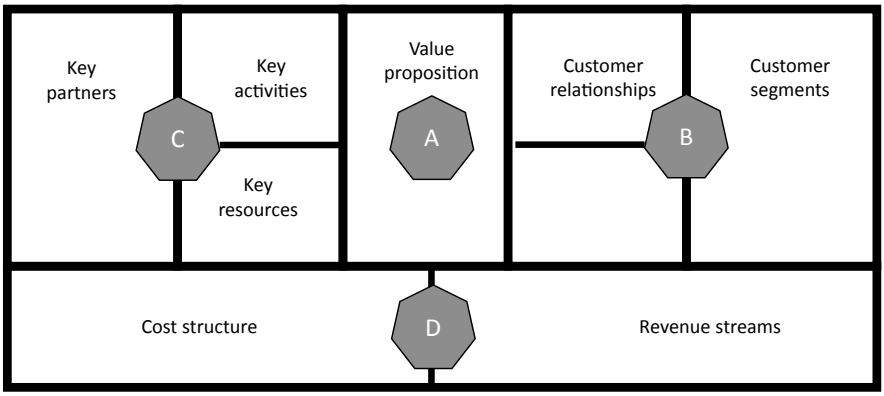

Fig. 3 The four dimensions of a business model mapped in a business model canvas. Adapted from Osterwalder (2004), Osterwalder et al. (2010). *Source* (Keane et al. 2018). *Note* A = Product; B = Customer Interface; C = Infrastructure management; D = Financial aspects

accomplished simply by including the smart contracts; maintaining easy involvement of the stakeholders in transparent and open transactions; achieving reduction in fraud and deception; increasing safety of raw materials and supplies by ensuring the provenance; and supporting crowdfunding and micropayments (Tapscott and Tapscott 2016; Nowiński and Kozma 2017). Furthermore, by the inherent decentralized nature of the blockchain and the structure of the trust it is more evident to achieve customer satisfaction and to provide better service and products.

Channels

To deliver the value proposition, the channels are utilized to reach out and to communicate to the customer segments. The customer experience is affected dramatically by the company's value proposition channels like use of a particular social media for branding; sales channel—online and brick–mortar; and distribution channels. Each typical channel provides different aspects to the customer, for example, customer can get aware of the product; customer can also get to experience the value proposition of the product or service by participating in the product/service demos, etc. By utilizing blockchain-based network, one can achieve the authenticity and provenance of the product or service. The integrity of the involvement of the channels and flow of information can be coded into smart contracts of the utilization of the channels to deliver value propositions to the customer segments. Channels will also be affected by the use of APIs and interfaces.

Customer Relationships

This element captures the types of customer relationships that exist between the company and the customer segments. The organization can use manual, automated, and hybrid processes to establish fruitful customer relationships by engaging in customer acquisition and customer retention contributing got growth in sales and better customer experience and satisfaction. Companies can look for operational efficiency as one way to build strong customer relationships as this will not only help in reducing time, efforts, and costs but also provide better experience. By including blockchain, the operational efficiency of the process can be performed at ease, for example, automobile company can quickly transfer ownership through the smart contracts once all the formalities to own the car is over. In addition, the micropayments will help to get reduction in interest rates and settlement of the transaction to happen faster without the intermediaries (Nowiński and Kozma 2017; Morabito 2017).

Revenue Streams

It is the critical element of the business model as it generates the revenue, "fuel for the engine," to provide value propositions. Each revenue stream is targeted to specific customer segment to achieve the potential revenue for the products and serviced. Further, the revenue stream can be fixed, dynamic, volume-dependent or hybrid leading to different impacts on the revenues. By including blockchain, organizations can develop new services and platforms to streamline customer engagements, loyalty ownership, and shared economy.

Key Resources

The key resources drive the value proposition, establish the customer relationships, and strategize the revenue streams. The resources (physical, financial, intellectual, or human type) can be utilized in the varieties of the ways, for example, human resource can be directly utilized, or hired as tenured based on co-partnership or just engage projects through outsourced model of engagements The machinery can be sold with the service model. It is essential to implement blockchain to consider the resource for the infrastructure—decentralized network, vast computing, and storage facility; relevant software and hardware platforms; capability to govern and drive the infrastructure—conceptualize, strategize, materialize, and maintain the infrastructure; expertise and skill set, develop smart contracts, and automate processes; and financial viable system—to utilize private, public, or consortium blockchains (Swan 2015; Beck and Müller-Bloch 2017; Xu et al. 2017).

Key Activities

The key activities describe the functioning part of the business model i.e., what activities organizations must execute to generate the value proposition to the customer segments. These activities differed depending on the type of the business model, for example, one might be interested in exploiting network/platform to provide values to the participants. When implementing blockchain, several activities need to be streamlined and strategized to get the maximum benefit. Blockchain affects greatly to the activities related to the supply chain management, for example, provenance of raw materials and supplies and openness of the data and transaction help the complete supply chain to expedite and control the processes. Further, the smart contracts and services like "proof of existence" ease the execution of business process and involvements of the participants to achieve the significant value proposition.

Key Partners

It is the critical key partner element that establishes the partnership to achieve business goals. Typically, the partnership falls into four categories, namely, strategic alliances between noncompetitors, competition: strategic partnerships between competitors, joint ventures to develop new businesses, and buyer–supplier relationships to assure reliable supplies (Osterwalder et al. 2010). With blockchain, vital partnership will be developed, managed, and served easily as no intermediaries are involved and each partner can validate the transactions.

Cost Structure

The cost structure depicts the cost model to generate the value proposition. It is of two types: cost-driven and value-driven. Furthermore, it is categorized based on the characteristics such as fixed, costs, dynamic costs, economies of scale, and economies of scope. Variable costs and operational expenses in a business model are explained in the cost structure element, which can be of cost-driven or value-driven structure (Osterwalder et al. 2015). Blockchain affects the operational

efficiency of the organizational processes in generating and delivering the value proposition, for example, shortening the time for the execution of transactions and by facilitating transactions of smaller sizes, to the customer segments.

New Partnership Models as Business Model Innovation

Blockchain is the impeccable technology to harness various opportunities and reform business models for business growth. Blockchain establishes trust and partnership into a new business model which was not possible earlier. Now with the help of blockchain-based record-keeping capability, institutions need not concern about the trusted third parties or intermediaries as the data and information are open, transparent, and available to all. There is no central authority for the data, information, and the processes. The transaction of the ownership of value and economy of share is possible.

Blockchain is more beneficial to a business when it involves multiple actors. It can affect the customer interface by empowering customers to not only own the data but also to control the way that it can be used in a variety of a business case. Blockchain empowers its customers to get involved in the value production and thus affects the product and the infrastructure management dimensions. Furthermore, by involving open and transparent transactions and micro-payment models, the dimensions such as customer interface, infrastructure management, and product are greatly affected. Nonetheless, the financial dimensions, more specifically the nonprofitable ones like micropayments, will also be affected and in turn affect the customer interface and infrastructure management. Similarly, by introducing crowdfunding models like ICOs, financial, customer interface, and infrastructure management dimensions will be affected. The organization embarking on the journey to embrace blockchain technology must understand that the impact of its inclusion has multidimensional effect on business models. The new business models will consider more involvement of users and partners. The new business models will not only see more participation from users and partners but will also discover the faster delivery of the values, increase in flow and availability of the information, empowerment of the users to initiate crowdfunding and crowdsourcing, etc. Furthermore, business will be transformed by utilizing faster and more profitable processes, embracing new business opportunities, and adhering to the higher transparency of products, companies, and users. It may be noted that customers have more involvement in the value production and thus showcase a threat to the existing business. In such cases, business has to strategize the way to incorporate customers into their value chain and other models like crowd involvement (funding and sourcing). Nonetheless, blockchains' main effect on business models will be the increased merging of users, the value production, and the companies that produce the value. Table 2 summarizes blockchain effects on the business models.

Table 2 Summary of blockchain effects on business models

	Product	Customer interface	Infrastructure management	Financial
Disintermediation		X	X	X
Improving operational efficiency		X	X	X
Changing reputation role		X	X	
Empowering user	X	X		
Microeconomics		X	X	X
Crowdfunding		X	X	X
Authenticating using digital identities	X	X		

Following questions are helpful to address and evaluate the business case for blockchain adoption:

- How to utilize blockchain to generate value?
- Are there clear alignments of the organization's goals and strategies with the blockchain?
- Does the organization have skilled resource and partnerships in place?
- What are the major goals for the organizations in terms of customer segments, customer relationships, and value offerings?
- Will blockchain help service customer needs better and offer more value?
- Will blockchain tighten relationships inside the supply chain?
- Does incorporation of smart contracts in the business processes reduce costs, risks, and delays?
- Are there any improvements in the organizations' cost structures?
- How easy or difficult to integrate blockchain with the existing infrastructure?
- Are there benefits of using blockchain in reducing search, coordination, and negotiations costs?
- Does organization get competitive advantage with the blockchain?

Concluding Remarks

Businesses have to discover and navigate the business opportunities to unleash the potential of the blockchain. To capture the real value of the blockchain, we need to understand the business model environment. The business model does not run in isolation and is affected by the business model environment. There exist four critical factors, key trends, macroeconomic forces, market forces, and industry forces, that influence the business model of organizations. Blockchain surmounted

by its decentralized and transparent structure to support transactions of values might be affected by and contribute to the business environment forces from macro- to microscopic view.

References

Beck, R., & Müller-Bloch, C. (2017). Blockchain as radical innovation: A framework for engaging with distributed ledgers. In *Proceedings of the 50th Hawaii International Conference on System Sciences* (pp. 5390–5399).

Crosby, M., Pattanayak, P., Verma, S., & Kalyanaraman, V. (2016). BlockChain technology: Beyond bitcoin. *Applied Innovation Review, 2,* 6–19.

Dasilva, C. M., & Trkman, P. (2014). Business model: What it is and what it is not. *Long Range Planning, 47,* 379–389.

European Commission. (2016). Data protection in the EU. European Commission. Retrieved April 20, 2019, from https://ec.europa.eu/info/law/law-topic/data-protection/data-protection-eu_en.

Marsal-Llacuna, M. L. (2018). Future living framework: Is blockchain the next enabling network? *Technological Forecasting and Social Change, 128,* 226–234.

McKinsey. (2015). Industry 4.0. How to navigate digitalization of the manufacturing sector. McKinsey Digital. Retrieved February 16, 2019, from https://www.mckinsey.de/files/mck_industry_40_report.pdf.

Morabito, V. (2017). *Business Innovation Through Blockchain: The B3 Perspective*. Switzerland: Springer International Publishing AG.

Nowiński, W., & Kozma, M. (2017). How can blockchain technology disrupt the existing business models? *Entrepreneurial Business and Economics Review, 5*(3), 173–188.

Osterwalder, A. (2004). *The business model ontology—A proposition in a design science approach*. Switzerland: Universite de Lausanne.

Osterwalder, A., Pigneur, Y., & Tucci, C. L. (2005). Clarifying business models: Origins, present, and future of the concept. *Communications of the Association for Information Systems, 16.*

Osterwalder, A., Pigneur, Y., Bernarda, G., & Smith, A. (2015). *Value proposition design: How to create products and services customers want*. John Wiley & Sons.

Osterwalder, A., Smith, A., Clark, T., Pijl, P. V. D., & Pigneur, Y. (2010). *Business model generation: A handbook for visionaries, game changers, and challengers*. N.J., John Wiley: Hoboken.

Pila, J., & Torremans, P. (2016). *European intellectual property law*. Oxford: Oxford University Press.

Sun, J., Yan, J., & Zhang, K. Z. (2016). Blockchain-based sharing services: What blockchain technology can contribute to smart cities. *Financial Innovation, 2*(1), 26–35.

Swan, M. (2015). *Blockchain: Blueprint for a new economy*. California: O'Reilly Media Inc.

Wirtz, B. W., Pistoia, A., Ullrich, S., & Göttel, V. (2016). Business models: Origin, development and future research perspectives. *Long Range Planning, 49,* 36–54.

Xu, X., Weber. I., Staples, M., Zhu, L., Bosch, J., Bass, L., et al. (2017, April). A taxonomy of blockchain-based systems for architecture design. In *2017 IEEE International Conference on Software Architecture (ICSA),* Conference Paper.

Zott, C., Amit, R., & Massa, L. (2011). The business model: Recent developments and future research.

Chapter 5
Roadblocks

Life will throw all kinds of obstacles our way. It's our job to scramble over them and hunt for the little miracles tucked away, then leave some reminders for the people that follow behind us.
—Emily Page, Fractured Memories: Because Demented People Need Love, Too

A ship doesn't sink because it is in the ocean in the midst of a storm. It only sinks when the hull is breached, and the ocean get inside it.
—Arthur Jackson Jr., Out of the Darkness

Abstract Adoption of a blockchain technology is challenging in terms of both feasibility and viability to both parties involved in generating the values. In this chapter, readers will understand the roadblocks—challenges in the blockchain space, thereby enabling them to charter appropriate strategies and tactics.

Introduction

There exist numerous challenges with the blockchain, even though the blockchain adoption seems to be a viable choice for improving processes, workflows, and businesses. The scholars and practitioners are making efforts to define the appropriate business model for the proper functioning and adoption of the blockchain. The early adopters face numerous roadblocks due to the uncertainty in the development of the technological stack and ecosystem, unclear regulatory guidelines and compliances, and network community to build and scale-up the development, see Fig 5.1.

Technological Stack and Ecosystem
Blockchain is still in its nascent stage with few successful projects. Either most of the projects are in the conceptual stage or testing is being performed on the prototypes. Novelty in the technology also put limitations in the way that the technology can be used for developing a wide variety of applications. The development

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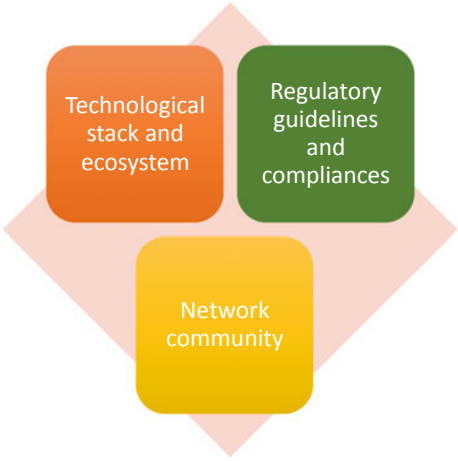

Fig. 5.1 Early adopters' challenges

platform and stack are not fully operational, functional, and standardized which give limited choice to the community. Table 5.1 depicts some popular projects which are realized (fully/partially), planned, or anticipated.

Regulatory Guidelines and Compliances

Most of the business domains, such as financial services, healthcare, energy, etc., that could have a drastic impact and growth opportunity are heavily trapped in the regulatory guidelines and compliances. Moreover, strict government-imposed functions, jurisdiction-based laws and governance, information security, and privacy issues make operations little complex for the smooth functioning of the business processes and workflows. Blockchain applications such as virtual currencies fall into the gray area which is not clearly covered and defined by the regulatory bodies. However, it is anticipated that when the blockchain technology gets matured, its adoption across various sectors will be easy.

Network Community

It is important to note that blockchain will proliferate when it scales up the network effects as the technology cannot grow in isolation. It is also critical to have large user base leveraging blockchain applications and partners to facilitate development and deployment of the blockchain applications. The underlying complexity, such as hash function and cryptography, in the technology, is hard to understand by the nontechnical community which hinders the widespread adoption.

Table 5.1 Prospective and realized projects

Projects	Description	State	Examples
Management of property rights and ownership	Primarily focus on property, digital rights management, copyright, and ticket services	Realized	Creative chain blockphase aventus
Management of IP rights	The focus is to track, manage, and control the intellectual property rights	Realized	
IOT	The purpose is to enable and activate machine-to-machine transactions		Ethereum blockstack, IoTA
Management of financial services	Asset management, investment trading, and crowdfunding	Realized	Ripple open ledger swarmfund
Management of shared economy	The purpose is to enable the shared economy platform	Planned	
Platforms for smart contracts	The focus is to develop, manage, control, and execute smart contracts	Planned	Ethereum Blockstack
Decentralized organizations	The purpose is to govern and enable smart optimization of resources	Anticipated	
Management of supply chain	The purpose is to manage, control, monitor, and track the items on the supply chain	Planned	
Voting	The purpose is to empower the citizens to vote transparently through online channels	Planned and partially realized)	Follow my vote, backfeed crowd jury
Management of identity	The purpose is to provide self-sovereign digital identity and authentication	Realized	Civic, blockchain helix, bitnation

Challenges

In this section, I summarize the potential challenges of the blockchain. Further, I categorize the challenges under lack of clarity, governance and legal, security and privacy, and other aspects.

Lack of Clarity

The business stakeholders do not have a clear understanding of the potential business uses cases of the blockchain technology. The underlying complexity of the technology makes even difficult to identify and develop the business applications. Also, the short- and long-term benefits regarding the adoption, deployment, and usage are far to understand. Businesses perceived immaturity lack the proper strategy to adopt the blockchain technology for their benefits (Avital 2018; Beck and Müller-Bloch 2017). Besides, the nascent stage of the technology has created a huge gap in the skilled resource by which firms are facing challenges in developing

the potential for various business use cases and domains. The widespread adoption of the technology is also restricted due to the lack of sufficient knowledge, awareness, and potentials (Daniel and Zhu 2018). Further, the organizations which are taking a lead to embrace the blockchain technology are not untouched by risks such as incompatible blockchain models, poor interoperability, upfront high costs for "mining," and unclear running costs of the blockchain (Koteska et al. 2017; Li et al. 2018).

Leaders find it difficult to understand the organization's maturity model to adopt the blockchain as there is no consensus on the clarification and correctness of the blockchain maturity model. Moreover, it is also unclear to demarcate the business use case for different blockchain models—private, public, and hybrid due to the underlying complexity of the technology and the platform. Organization also needs to understand the interoperability and integration of the blockchain technology with their existing legacy systems and infrastructures so that the exchange between ledgers and organizations infrastructure happens seamlessly (Tschorsch and Scheuermann 2016). But, unfortunately, such a system exists in vain and recent development in technology showcases that businesses are unclear about their actions in restructuring systems, processes, and legacy IT structures (Tan et al. 2018; Smith 2018).

Following questions are helpful to address the lack of clarity issue:

- How to manage the permissioned and permission-less ledgers?
- How to identify, develop, and materialize business use cases?
- How to identify and develop skilled resources?
- How to manage the interoperability issues?
- How to identify the right blockchain business model?
- How to manage upfront and running costs?
- How to assess the blockchain maturity?
- How to utilize and deploy the robust infrastructure?
- How to establish the constructive discourse that can benefit the community?
- In what way the regulated off-chain equivalents are maintained?
- How to impart awareness and training programs?
- In what way the user-friendly tool, IDE, and interfaces are developed?
- How to incorporate strategize the corporate structure?

Governance and Legal

It is clear that the blockchain technology has no centralized authority or organization that controls and makes a decision rather everything is managed through decentralized peer-to-peer consensus-based ecosystem. At one point, it promotes openness, freedom, transparency, and trustless systems but on the other side there is no safeguard and no one is responsible for the standards. It is not clear how to develop and maintain standards, features, and upgrades in a decentralized manner until there exists some centralized way to govern the standards, for example,

Ethereum foundation ecosystem. Both permissioned and permission-less ledgers face challenges. It is anticipated that once the network grows the permission-less ledger depending upon the design lead to high aggregated costs. The governance for the permissioned ledger needs to incorporate proper accountability related to number of participants, their role and responsibility, and terms of use. Besides, considerations such as ownership activation leading to automatic execution of the permissions, management of protocols and keys, management of regulations to govern the ledgers, and applications are critical.

In some cases, the processing of the transaction and decision-making is affected by the periodic "forks: and thus be managed safely. It is critical to have proper regulatory guidelines when the cross-border processes and transactions are executed which involves interledger interaction. There exist several other challenges related to smart contracts and its mapping to the natural language. Too complex agreements are difficult to map with hardwired smart contract code and thus manual intervention or inclusion of third party is required (Goldenfein and Leiter 2018). Overall, blockchain governance is an incredibly tricky problem and finding a balance between centralized and distributed control will be key to keeping development on the right path. It is a necessary condition for all the participating nodes in the blockchain network to process every transaction, thus creating the problem of scalability. The decentralization structure inherently limits the number of transaction that can be processed and also the time required to process each transaction block. For example, Bitcoin block transaction process requires 10 minutes, while Ethereum block transaction process gets completed in 14 seconds. It is critical to increase the storage, bandwidth, and computing power of the fully participating nodes when the network also grows. Püttgen and Kaulartz (Püttgen and Kaulartz 2017) mention that blockchain holds a promising solution to the insurance industry but lacks the jurisdiction-specific ontology and regulation for insurance smart contracts.

Following questions are helpful to address the governance and legal issue:

- How to manage the scalability without affecting (weakening) the network?
- How to incentivize the community for the mass collaboration?
- How to maintain and manage the sustainable energy for the operations?
- How to manage the consensus by avoiding the major consensus threats?
- Do not fix an app-layer problem with a protocol-level solution.
- In what way one can manage the switch to proof of stake?
- How to develop standards considering the decentralized nature?
- How to deploy the robust infrastructure?
- How to establish the constructive discourse that can benefit the community?
- In what way the regulated off-chain equivalents are maintained?
- How to develop the skilled resource?
- In what way the user-friendly tool, IDE, and interfaces are developed?
- How to incorporate a proper legal structure?

Security and Privacy

It is easy to create a new wallet anonymously and start transactions over the blockchain as the technology promises pseudonymity. The transactions are not attached with any real-world identity, and thus it is impossible to track the transaction originator. But, when connections are established, then it becomes easy to deanonymized. In one case, law enforcement has revealed that they could identify specific Bitcoin users during investigations and thus they broke the inherent and fundamental principle of the technology—blockchain's total transactional invisibility. Normally, with the web cookies and web trackers on the merchant websites, it is incredibly easy for the organizations or even hackers to unfold the transactions. Moreover, smart contracts on the blockchain platform such as Ethereum contain more valuable information apart from just simple value transfers. The details like sender's and recipient's information (virtual), smart contract details, smart contract code, state inside the contract, and transaction data are easily available on the blockchain and are critical for any business.

There exist many critical issues related to security and privacy regarding the consensus mechanisms as one can notice that the consensus mechanism drives the decision and transaction on the blockchain network. In case, more than 50% of the network is compromised, and then it becomes easy to manipulate the transaction (Conti et al. 2018). It is unclear to manage the data on the blockchain network considering its immutable nature when one wishes to remove the data. There are no guidelines and standards to deal with such an issue. Another challenge is to manage the access even during the loss/theft of the keys. Users need to be extra careful when they upgrade the software and system for further usage as they can become prone to privacy leakages. Further, there exists a possibility of surfacing a security risk when system undergoes a cyberattack or a failure as multiple copies of the ledgers that are available can be compromised leading to the undesirable "fork."

Following questions are helpful to address the security and privacy issue:

- How to manage the accountability of the participants in the network?
- How to maintain the pseudonymity (on and off the chain)?
- How to maintain and manage the smart contracts information leakage?
- How to manage the consensus by avoiding the major consensus threats?
- How to eliminate the forks?
- In what way one can manage the consensus process?
- How to develop standards considering the decentralized nature?
- How to deploy the robust infrastructure?
- How to manage the keys and protocols?
- In what way the multiple ledger copies are maintained?
- How to eliminate privacy leakages during system and software upgrades?

Other Challenges

Considering multiple copies over the decentralized network, the issues to trigger significant energy tasks are potent as it is not uncommon to initiate changes to the ledger. Moreover, moving away from the central authority to the decentralized

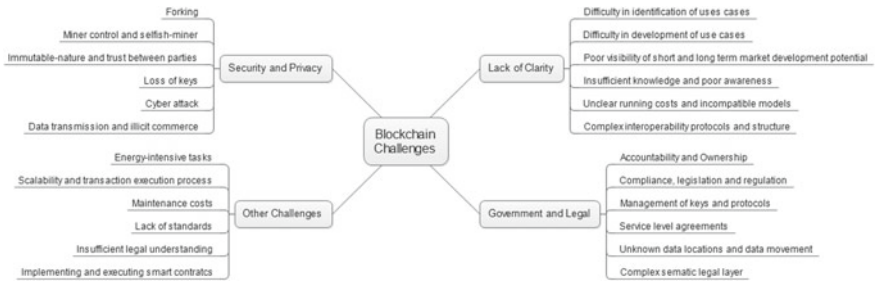

Fig. 5.2 Blockchain challenges

structure of running the systems, the maintenance of the blockchain network in a cost-effective manner is also becoming complex (Rifi et al. 2018). The smart contracts though typically reduce the bias, manual intervention, and delays in the process, the evidence shows a significant challenge in crafting complex smart contracts. Normally, it is easy to develop and deploy simple rule-based contracts. It is, however, not clear the legal understanding and coverage of the smart contracts due to its loose coverage of the complex agreements. Besides, it is difficult to precisely define and map legal code into smart contracts mentioning roles and responsibilities, terms of use and agreements, accountabilities, liabilities, business logic, business entities, participating parties, etc. (Püttgen and Kaulartz 2017). Miners in the blockchain network can process the transaction with the help of the hash function (Eyal 2017). Zhang et al. (2018) present the issue of energy power distribution and loading transaction due to the rise of electric vehicles (EVs). The authors assert that high intermittency and variability issues can crop in due to the significant rise in the usage of the EVs. Figure 5.2 summarizes the blockchain challenges.

Drivers of Business Model Innovation

Sosna et al. (2010) advocate the utility of organizational learning process in innovating the business model. Moreover, certain dynamic capabilities, such as strategic sensitivity and resource fluidity (Doz and Kosonen 2010), contribute to the increased propensity of the business model innovation (Hock et al. 2015). Strategic sensitivity and resource fluidity provide multiple benefits, and thus addressing them carefully is the utmost challenge for the organization and requires the ability to

- forecast the usage of the future products;
- try, experiment, and learn from new business models;
- distance leadership from daily operations;
- use networks to avail the benefit of the third-party perspective;
- distinguish between generalizable and contextual aspects of business model;

- imagine and conceive new business models;
- achieve increased autonomy in coordination;
- modularize underlying business processes and IT infrastructure;
- operate multiple business models simultaneously;
- craft new ideas from acquired businesses.

It has been observed that whenever there is a change in the technology it leads to a change in the business model (Teece 2010), for example, the introduction of the Internet has changed the value delivery and cost aspects of the business models. Moreover, the technology helps organizations to deliver different values using different channels. The blockchain technology impacts the business model, and various challenges are associated with strategic, value creation, customer, and market components.

Strategic Component

- *identification of the potential business use case,*
- *management of the changing role of reputation, and*
- *management of the network extensions based on the transaction security.*

Value creation component

- *management of value delivery,*
- *management of safety,*
- *identification of the distribution channels,*
- *execution of the crowdsourcing platforms, and*
- *deployment of the contracts.*

Customer and market component

- *management of smart contracts for negotiations,*
- *identification of personalized value delivery system, and*
- *management of micropayments.*

Concluding Remarks

There exist numerous challenges with the blockchain, even though the blockchain adoption seems to be a viable choice for improving processes, workflows, and businesses. The early adopters face numerous roadblocks due to the uncertainty in the development of the technological stack and ecosystem, unclear regulatory guidelines and compliances, and network community to build and scale-up the development. Further, other challenges such as lack of clarity, governance and legal limitations, security, and privacy issues need prompt attention. The blockchain technology impacts the business model, and various challenges are associated with strategic, value creation, customer, and market components.

References

Avital, M. (2018). Peer review: Toward a blockchain-enabled market-based ecosystem. *Communications of the Association for Information Systems, 42*(1), 646–653.

Beck, R. & Müller-Bloch, C. (2017). Blockchain as radical innovation: A framework for engaging with distributed ledgers. *Proceedings of the 50th Hawaii International Conference on System Sciences*, 5390–5399.

Conti, M., E, S. K., Lal, C. & Ruj, S. (2018). A survey on security and privacy issues of bitcoin. IEEE Communications Surveys and Tutorials. https://doi.org/10.1109/comst.2018.2842460.

Daniel, F. & Zhu, L. (2018). Blockchains for business process management—challenges and opportunities. *ACM Transactions on Management Information Systems*, *9*(1).

Doz, Y.L. & Kosonen, M. (2010). Embedding strategic agility: A leadership agenda for accelerating business model renewal. *Long Range Planning*, *43*(2–3), 370–382. Retrieved March 15, 2017 from http://dx.doi.org/10.1016/j.lrp.2009.07.006.

Eyal, I. (2017). Blockchain technology: Transforming libertarian cryptocurrency dreams to finance and banking realities. *Computer, 50*(9), 38–49.

Goldenfein, J. & Leiter, A. (2018). Legal engineering on the blockchain: 'Smart contracts' as legal conduct. *Law and Critique*, 1–9.

Hock, M., Clauss, T. & Schulz, E. (2015). The impact of organizational culture on a firm's capability to innovate the business model. *R&D Management*, *46*(3), 433–450. Retrieved March 15, 2017 from http://dx.doi.org/10.1111/radm.12153.

Koteska, B., Karafiloski, E. & Mishev, A. (2017). Blockchain implementation quality challenges: A literature review. Paper presented at the CEUR Workshop Proceedings, 1938.

Li, D., Cai, Z., Deng, L., Yao, X. & Wang, H. H. (2018). Information security model of block chain based on intrusion sensing in the IoT environment. *Cluster Computing*, 1–18.

Püttgen, F. & Kaulartz, M. (2017). Insurance 4.0: The use of blockchain technology and of smart contracts in the Insurance Sector. (Versicherung 4.0: Nutzung der Blockchain-Technologie und von Smart Contracts im Versicherungsbereich) *ERA Forum*, *18*(2), 249–262.

Rifi, N., Rachkidi, E., Agoulmine, N. & Taher, N.C. (2018). Towards using blockchain technology for IoT data access protection. Paper presented at the 2017 IEEE 17th International Conference on Ubiquitous Wireless Broadband, ICUWB 2017—Proceedings, 2018-January 1–5.

Smith, T. D. (2018). The blockchain litmus test. Paper presented at the Proceedings—2017 IEEE International Conference on Big Data, Big Data 2017, 2018-January (pp. 2299–2308).

Sosna, M., Trevinyo-Rodríguez, R. N., & Velamuri, S. R. (2010). Business model innovation through trial-and-error learning: The Naturhouse Case. *Long Range Planning, 43*(2–3), 383–407. https://doi.org/10.1016/j.lrp.2010.02.003.

Tan, A. W. K., Zhao, Y., & Halliday, T. (2018). A blockchain model for less container load operations in China. *International Journal of Information Systems and Supply Chain Management, 11*(2), 39–53.

Teece, D. J. (2010). Business models, business strategy and innovation. *Long Range Planning, 43* (2–3), 172–194.

Tschorsch, F., & Scheuermann, B. (2016). Bitcoin and beyond: a technical survey on decentralized digital currencies. *IEEE Communications Surveys and Tutorials, 18*(3), 2084–2123.

Zhang, P., Schmidt, D.C., White, J., & Lenz, G. (2018). Blockchain technology use cases in healthcare.

Chapter 6
Big Ideas

The great enemy of truth is very often not the lie–deliberate, contrived and dishonest–but the myth–persistent, persuasive and unrealistic. Too often we hold fast to the cliches of our forebears. We subject all facts to a prefabricated set of interpretations. We enjoy the comfort of opinion without the discomfort of thought.

—John F. Kennedy
(Commencement Address at Yale University, June 11 1962).

If you have a good idea, use it so that you will not only accomplish something, but so that you can make room for new ones to flow into you.

—Deng Ming-Dao, Everyday Tao: Living with Balance and Harmony.

Abstract Blockchain is disrupting every domain of the business and part of human life and society. What is your big idea? In this chapter, readers will be exposed to conceive, design, and develop their big ideas for blockchain space to disrupt the market.

Introduction

Traditionally, the centralized authority institutions facilitate trade and commerce by managing the risks, but by using blockchain technology, it is possible to lower the risks and cost of a transaction. Such kind of transformation has a likely impact on the global economy and is predicted to have business value of over $3 trillion by 2030 (Avital 2018; McKinsey 2015). The major drivers of the transformation are lucid cash flow, easy provenance of assets, and availability of native asset, and more importantly, access to effective trust-based business models (Smith 2018).

The blockchain technology gave rise to the virtual currencies, as its first application, as an alternative to the fiat currency. As the technology matured, more advanced solutions for transaction and ownership based on smart contracts started becoming evident (Beck and Müller-Bloch 2017). The blockchain network supports

N. Upadhyay, *UnBlock the Blockchain*,
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transaction of values of all kinds of assets, physical or virtual. In this chapter, we will explore the current landscape of the potential applications and use cases and develop the framework that will help us to evaluate our big ideas for the blockchain space. One thing we need to take into cognizance the regulatory and legal framework is not quite matured and thus hinders the mass adoption of the blockchain (Daniel and Zhu 2018).

The cryptocurrency was evolved as the substitution application based on the single use case and localization applications, Fig. 3.2. It represents the value digitally. It is accepted by the parties involved in the transactions, for example, consumer and merchant, and does not link with the fiat currency. Moreover, it is not issued by any private bank or the public authority. The availability of the cryptocurrency as an alternative way for the transactions of value empowered the participating community at large. Both the consumer and merchants are interacting in a deal benefitted by not just by the timely completion of the transaction but also with the lower cost of the transaction. Cryptocurrency can be transferred, stored, or traded electronically.

Blockchain Technology Stages

The blockchain technology has transformed through four stages—blockchain 1.0, blockchain 2.0, blockchain 3.0, and blockchain 4.0, see Fig. 6.1. While the world has witnessed successful utilization of blockchain 1.0 and blockchain 2.0, the usage capability of the blockchain 3.0 and blockchain 4.0 is underway.

Blockchain 1.0
It focuses on the decentralized peer-to-peer consensus-based model to support transactions of value. Perhaps, the most famed application is the Bitcoin, a decentralized cryptocurrency, for supporting financial transactions of value (Morabito 2017; Doz and Kosonen 2010; Eyal 2017). Such kinds of applications do not require any intermediaries for completing the transactions.

Blockchain 2.0
It is the extension of the blockchain 1.0 that means it inherits all the capabilities and benefits of the blockchain 1.0 and added extra features such as privacy, smart contracts, and non-native blockchain tokens (Goldenfein and Leiter 2018; Hock et al. 2015). The well-known platform that supports the smart contract is the Ethereum.

Blockchain 3.0
It further expanded the focus to the inclusion of the decentralized applications (DApps). The DApps runs as a back-end code over the decentralized peer-to-peer network, which connects the users and the providers directly (Marsal-Llacuna 2018). Further, the DApps should have clear transparent and incentivized structure and support flexible, open, distributed, and resilient design (Püttgen and Kaulartz 2017).

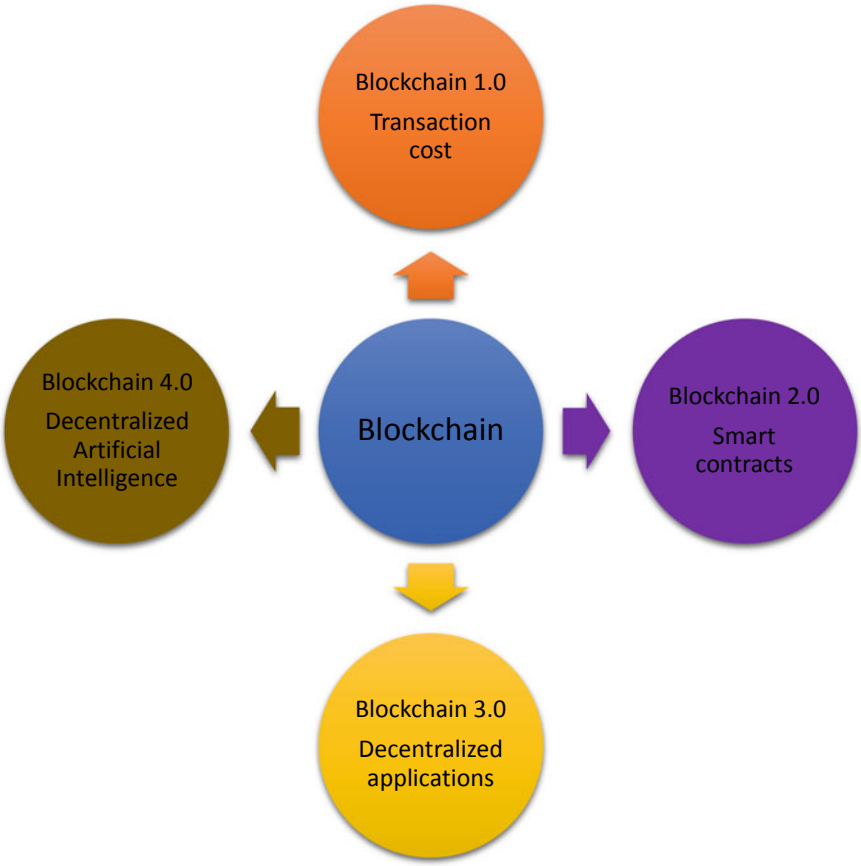


Fig. 6.1 Blockchain stages

Blockchain 4.0

Each blockchain stage promises to create new markets and business models. The blockchain 4.0 is the new stage that tries to integrate the potential of the blockchain with the artificial intelligence domain (Nowiński and Kozma 2017; Rifi et al. 2018). One of the prominent service providers that deals with blockchain 4.0 is the CognitiveScale, an AI startup supported by IBM, Intel, Microsoft, and USAA, to provide AI-enabled solutions for the regulatory compliance in the financial markets.

It is observed that for the value creation it is important to understand the functionalities to drive and deliver the value rather than the technology (Sosna et al. 2010; Tan et al. 2018). Each blockchain stage supports various enablers to generate value but each stage will provide different values. Table 6.1 summarizes the value enablers and value drivers.

Organizations need to understand that the adoption of the blockchain technology does not start with blockchain 1.0; rather, it depends on the various factors such as

Table 6.1 Value enabler and value driver

Blockchain stage	Value enabler	Value driver
Blockchain 1.0	Decentralized peer-to-peer consensus	Transaction cost
Blockchain 2.0	Smart contracts	Extra and added services
Blockchain 3.0	Decentralized peer-to-peer applications, storage, and computing service	Organization scope and boundaries
Blockchain 4.0	Decentralized peer-to-peer artificial intelligence	Autonomous agents and decision-making

services to be offered, technology that can be managed, and value to be delivered. Also, the comparison regarding the service with the added value must be done within the respective stage services.

Value Registry and Transaction

Traditionally, the central authority was responsible for the recording and maintaining of the documents by way of registration. The parties involved in the transaction of the assets, for example, land asset, could verify and validate the ownership of the land by way of checking land registry and then could execute the required transaction. But it is possible to do the same with the blockchain, without the involvement of intermediaries—registering authorities, to digitally register any "value" on the blockchain. A distributed ledger facilitates the record of the "value," and thus parties can retrieve the record and verify and validate the ownership of the "value" as there exists only one truth on the ledger. One can record assets like land, patent, etc.

Moreover, the value registry on the blockchain help in many ways, for example, by using the proof of existence, one can register the existence of the document by using the digital digest (digital signature and timestamp) of the document and can use it at a later stage by native blockchain mechanisms. The physical asset can be registered by putting a digital reference of the asset on the blockchain, and once the transaction of the record creation is confirmed, then the record is publicly available. The owner of the private key associated with the public record of the asset is registered and treated as the owner of that asset. Another way of using the blockchain is by registering the identity. Once the identity registry is created, it can be later verified and validated at any given point. The identity management system of the blockchain is helpful in many use cases such as voting, identity frauds, scheme benefits, etc. Once the value is registered on the blockchain, it can be used for the value transaction. The distributed ledger gets updated once the transaction of the amount is confirmed.

Value Ecosystem and Web

The blockchain is also gaining momentum by the involvement of people contributing to the development of its ecosystem and value web. All parts of the ecosystem need to work together to develop a fully functional value web. Blockchain infrastructure provider supplies the necessary infrastructure to set up the distributed ledger, blockchain service and solution components, and interface components to both user and the developer communities. Blockchain application provider will engage in the development of DApps and provide application development services in different domains and sectors.

Further, the blockchain platform provider provides the platform on which the blockchain solutions will be developed, tested, maintained, and run. Token-based community platform provider will also get flourished and contributes to the development of the token-based reward system and community based on the internal token distributed reward system. The miner pool will also grow both in computational and storage capabilities to process the blockchain transactions. Blockchain consulting service provider will gain attention as they will be critical to build the capacity, evaluate the technology and industry maturity, and provide the appropriate solutions to run the successful blockchain projects. The participation of the consumers and the blockchain community is critical to the overall ecosystem. Mining equipment's and solution provider will also play a significant role as the quality solutions will result in useful and timely outcomes in terms of successful transactions. The synergistic interplay of the ecosystem actors will lead in the creation of the value web, "Internet of Value." Figure 6.2 shows the blockchain value.

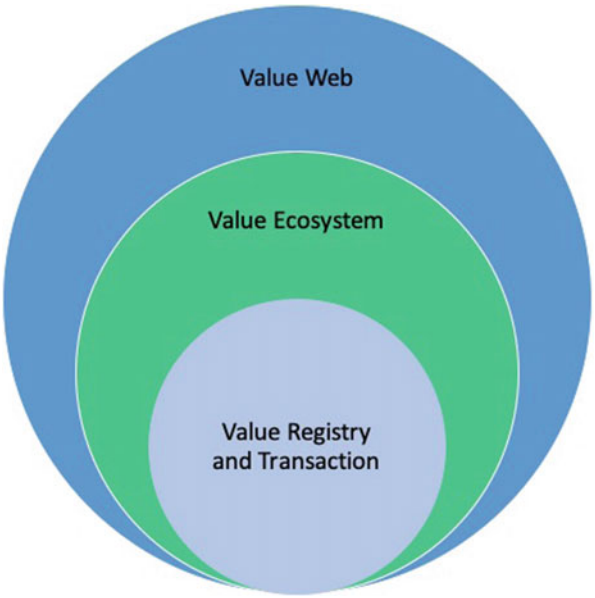


Fig. 6.2 Blockchain value

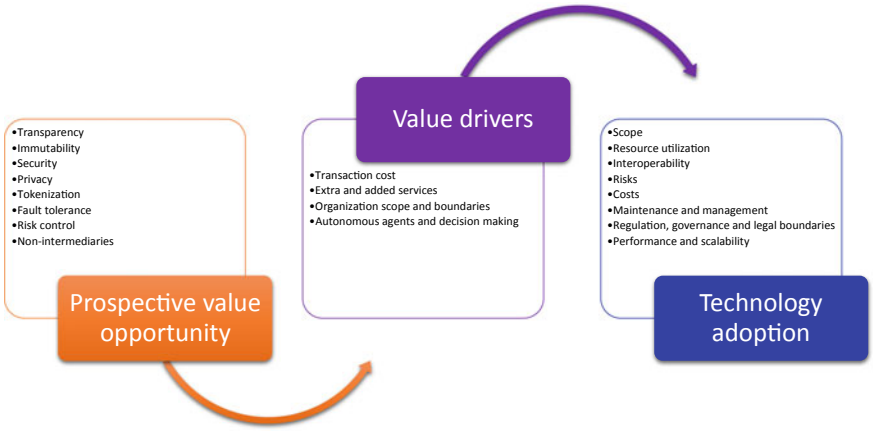


Fig. 6.3 Value analysis and technology adoption

Value System

Organizations looking forward to embrace the blockchain technology need to begin with identifying the prospective value opportunity and the enabling blockchain technology. Unlike other technologies' maturity model, the blockchain technology adoption is different and its adoption is driven by the necessity of the actual service being offered, and value drivers to impart the solutions. Value drivers at each stage result in different value offerings such as reduction in transaction cost, extra and added services, restructure of organizations' scope and boundaries, and inclusion of autonomous agents and decision-making. Further, organization also must assess the impact, feasibility, and viability of the blockchain technology. Concerns such as development of skilled resources, establishments of co-partnerships, execution of governance, and regulatory frameworks are paramount. Figure 6.3 shows the value analysis and technology adoption framework.

Blockchain Idea Brainstorm (BIB)

It is essential to develop blockchain ideas and check the prospects early before you get trapped into the "deep regrets." The blockchain idea brainstorm (BIB) template helps to capture and illustrate your idea. Once your idea is captured and explained clearly, then you can use the blockchain idea evaluation framework to validate the feasibility of the idea.

Identify the domain and the market segment for your potential blockchain idea. It does not matter which industry you belong to whether it is Education or Finance (Large/Medium/SME); it is imperative that you wish to solve a problem and that is

Table 6.2 Checklist

Checklist	Yes	No
Do you need a database for the records?		
Do you have multiple members updating records in the database?		
Do these members need to trust each other?		
Do you have any third-party involvement?		
Do you face any problem by the third party?		
Does the transaction depend on each other?		
Do you have assets of "value" to be represented digitally?		

the reason you need to identify the potential domain and then capture the segment. To gain more in-depth knowledge about your market segment, you may run a few experiments or qualitative surveys. You need to draft the problem statement which should not be more than 100–150 words, which clearly state issue to be addressed or condition to be improved upon. Identify the potential stakeholders having the stake in the problem-solution space, which means who all get affected by it. Next, describe the applicability of the blockchain opportunity by considering the checklist. The checklist guides you to understand whether you can attempt blockchain technology for your problem or not, see Table 6.2. In case any of the questions in the checklist result to "No," then you need not go ahead with the blockchain, and you can find alter solutions for your problem. But, if all the checklist questions result into "Yes," then your idea is a good fit for the "Blockchain."

Blockchain Idea Brainstorm (BIB) Template - Example
Domain: Health Care

Market Segment: Drug testing research (Human subjects: Adult | Teen | Kids)

Problem Statement: In the drug testing research, on human subjects, the system lacks in transparency and trust—usage of protocols, alteration of data, violation of the code of conduct, the process of data collection, operation, analysis and validation, and early settlement.

Stakeholders: Subjects (human), healthcare professionals, testers, lab managers, supervisors, doctors, drug manufacturers, vendors, drug delivery manager and personnel, consumers, auditors, regulators, research ethics board, etc.

Checklist	Yes	No
Do you need a database for the records?	Yes	
Do you have multiple members updating records in the database?	Yes	
Do these members need to trust each other?	Yes	
Do you have any third-party involvement?	Yes	
Do you face any problems with the third party?	Yes	
Does the transaction depend on each other?	Yes	
Do you have assets of "value" to be represented digitally?	Yes	
Potential Solution–Blockchain	**Yes**	

Blockchain Idea Evaluation Framework (BIEF)

It is imperative for businesses to evaluate the blockchain idea before planning to invest in the blockchain project. A blockchain idea evaluation framework, as shown in Fig. 6.4, presents a useful way to assess the blockchain idea. There exists four lenses—blockchain artifact, legal and regulatory, finance, and operational by which any individual, group, or organization can check whether to proceed with blockchain idea or drop it, see Fig. 6.4.

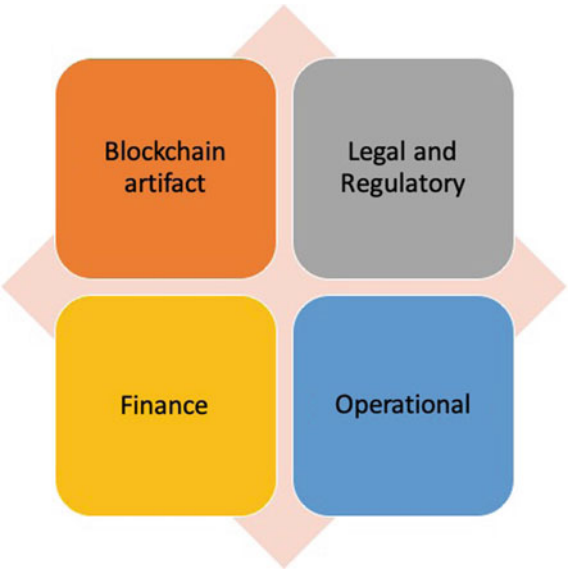


Fig. 6.4 Blockchain idea evaluation framework

Blockchain Artifact
In this stage, the objects like value registry and value transaction to be identified. You may need to identify the assets involved, the process of the transaction, the rules of the transaction, and the outcome. Also, the appropriate involvement of blockchain value ecosystem actors is needed. Score each of the available artifacts in the range 1–10. Score 10 means the artifact is available and can be used. Rating 1 means the artifact is unavailable.

Legal and Regulatory
Identify the legal and regulatory challenges as it might place a constraint in the design of your blockchain solution. Each jurisdiction poses different aspects related to the way that one can execute business processes. Identification of what is allowed and what not considering the strength and opportunity of the business use case help organizations to draft the specific strategy.

Finance
The finance is the core ingredient to drive the blockchain project to its success path. List down the sources of funding, the usage of investment considering the resources Capex and Opex, and other transactions, and develop the possible finance range for the deployment of the blockchain idea solution.

Operational
Identify the functional aspects of blockchain idea solution such as talent, resources; partners; primary, secondary, and tertiary resources; and activities for the smooth functioning of the blockchain idea solution.

Blockchain for Transforming Environment

Blockchain is considered to be truly transformative and affects the global environment. There exist many critical areas such as climate change, conservation, healthy oceans, water security, clean air, water, and disaster resilience, which need proper care to address various challenges, such as each environmental challenge area stands to benefit from the use and deployment of blockchain, and that the majority of solutions operate by transforming an underlying economic, industrial, or governance system. Many of the use cases also represent opportunities to unlock and monetize (or tokenize) economic value that is currently embedded within environmental and natural resource systems, which has been mostly unrealized to date. Examples include opportunities to build an inclusive bio-economy, capture the value of intact forests, and create new markets for trading natural resources.

Concluding Remarks

The blockchain technology has transformed through four stages—blockchain 1.0, blockchain 2.0, blockchain 3.0, and blockchain 4.0. It is observed that for the value creation it is important to understand the functionalities to drive and deliver the value rather than the technology. Unlike other technologies' maturity model, the blockchain technology adoption is different and its adoption is driven by the necessity of the actual service being offered, and value drivers to impart the solutions. The blockchain idea brainstorm helps to capture and illustrate idea. Further, the blockchain idea evaluation framework presents a useful way to assess the blockchain idea. There exists four lenses—blockchain artifact, legal and regulatory, finance, and operational by which any individual, group, or organization can check whether to proceed with blockchain idea or drop it.

References

Avital, M. (2018). Peer review: Toward a blockchain-enabled market-based ecosystem. *Communications of the Association for Information Systems, 42*(1), 646–653.

Beck, R. & Müller-Bloch, C. (2017). Blockchain as radical innovation: A framework for engaging with distributed ledgers. In *Proceedings of the 50th Hawaii International Conference on System Sciences* (pp. 5390–5399).

Daniel, F. & Zhu, L. (2018). Blockchains for business process management—challenges and opportunities. *ACM Transactions on Management Information Systems*, *9*(1).

Doz, Y.L. & Kosonen, M. (2010). Embedding strategic agility: A leadership agenda for accelerating business model renewal. *Long Range Planning*, *43*(2–3), 370–382. Retrieved March 15, 2017 from http://dx.doi.org/10.1016/j.lrp.2009.07.006.

Eyal, I. (2017). Blockchain technology: Transforming libertarian cryptocurrency dreams to finance and banking realities. *Computer, 50*(9), 38–49.

Goldenfein, J. & Leiter, A. (2018). Legal engineering on the blockchain: 'Smart contracts' as legal conduct. *Law and Critique*, 1–9.

Hock, M., Clauss, T. & Schulz, E. (2015). The impact of organizational culture on a firm's capability to innovate the business model. *R&D Management*, *46*(3), 433–450. Retrieved March 15, 2017 from http://dx.doi.org/10.1111/radm.12153.

Marsal-Llacuna, M. L. (2018). Future living framework: Is blockchain the next enabling network? *Technological Forecasting and Social Change, 128,* 226–234.

McKinsey. (2015). Industry 4.0. How to navigate digitalization of the manufacturing sector. *McKinsey Digital*. https://www.mckinsey.de/files/mck_industry_40_report.pdf. Accessed February 16, 2019.

Morabito, V. (2017). *Business innovation through blockchain: The B^3 perspective*. Switzerland: Springer International Publishing AG.

Nowiński, W., & Kozma, M. (2017). How can blockchain technology disrupt the existing business models? *Entrepreneurial Business and Economics Review, 5*(3), 173–188.

Püttgen, F. & Kaulartz, M. (2017). Insurance 4.0: The use of blockchain technology and of smart contracts in the Insurance Sector. *ERA Forum*, *18*(2), 249–262.

Rifi, N., Rachkidi, E., Agoulmine, N. & Taher, N. C. (2018). *Towards using blockchain technology for IoT data access protection*. Paper presented at the 2017 IEEE 17th International Conference on Ubiquitous Wireless Broadband, ICUWB 2017—Proceedings, 2018-January 1–5.

Smith, T. D. (2018). *The blockchain litmus test*. Paper presented at the Proceedings—2017 IEEE International Conference on Big Data, Big Data 2017, 2018-January (pp. 2299–2308).

Sosna, M., Trevinyo-Rodríguez, R. N. & Velamuri, S. R. (2010). Business model innovation through trial-and-error learning. *The Naturhouse Case. Long Range Planning, 43*(2–3), 383–407. https://doi.org/10.1016/j.lrp.2010.02.003.

Tan, A. W. K., Zhao, Y., & Halliday, T. (2018). A blockchain model for less container load operations in China. *International Journal of Information Systems and Supply Chain Management, 11*(2), 39–53.

Chapter 7
Success Stories

I have learned that success is to be measured not so much by the position that one has reached in life as by the obstacles which he has overcome while trying to succeed.
—Booker T. Washington, Up From Slavery: An Autobiography

If you treat the future something definite, it makes to understand it in advance and to work to shape it.
—Peter Thiel, Zero to One: Notes on Startups, or How to Build the Future

Abstract Successful organization showcase strength, commitment, risk-taking ability, and leadership excellence. In this chapter, success stories of ten different companies are discussed. The readers will be able to understand the challenges, opportunities, and useful lessons of blockchain solutions.

VAKT[1]

Problem

The oil and gas industry is conventionally considered to be a slow pace changing sector, but now it has been revolutionized by the digitization of its core processes. The digitized processes showcased promise to improve production and hauling efforts in a synchronized environment. But most of the physical trading life cycle is based on a conventional method resulting in high operational costs, delays, paper works, and huge risks. Moreover, the inclusion of third parties to execute the trading considering loans, transactions, finance, authorization, and validation now no longer prove to be beneficial.

Challenge

- produce transparent and new trade "trust-free" trading,
- enhance efficiency,
- reduce costs,

N. Upadhyay, *UnBlock the Blockchain*,
https://doi.org/10.1007/978-981-15-0177-7_7

– improve security,
– eliminate duplicate data, and
– remove paper works.

Description

Blockchain is changing the dynamics of the oil and gas industry by offering more transparency and control, leading to optimizing the operational time and costs. VAKT is a digital ecosystem, based on blockchain, for physical post-trade processing and is the consortium formed by nine major energy makers, independent bankers, and traders.

Solution

VAKT is reimagining the physical commodity post-processing trading and supply chain. A unique and common ledger is shared across all the participating parties by which each party can have at any given time the most updated records regarding every transaction. Parties can easily manage settlement and validate records (by removing paper works and duplicate data). Once the trade is executed between the trading parties, each of the parties updates the ETRM, which in turn placed the transaction records in the shared ledger. Once the trade transactions are matched and validated, the participating trade parties record the "single source of truth" and enter into secured transactions. The trading life cycle continues with confirmation, validation, and contract negotiation. The customers get easy finance approval by the banks based on the e-documents such as L/C, LOI, etc. The platforms promise to support the smart contracts for smooth execution of the agreements between traders; to provide tokenization to use it for various transactions; and to support integration with different markets. The platforms guarantee to reduce operational costs, delays, and risks.

Orvium[2]

Problem

The scientific publishing industry benefits the scholars, academicians, and practitioners as they get to know the latest and niche research articles and discoveries. The knowledge corpora generated by the scientific publishing industry is vast and is one of the most profitable in the world. The top five publishers' profit margins reported crossing the profit margins of the most successful companies like Google, Amazon, etc., as they account for almost 60–70% of all publications. The total global market for scientific, technical, and medicine publications crossed $25 billion marks. However, the research community is bearing all the costs and publication efforts and has no or less control over the copyrights on the contributions.

Challenge

- produce rewards and recognition for reviewers,
- enhance copyright ownership,
- reduce publication costs,
- improve the review process,
- eliminate low-quality contributions, and remove biased review and contributions.

Description

Orvium is a leading publishing platform for the scientific community. It aimed to improve the processes regarding scientific publishing and eliminates market inefficiencies.

Solution

The Orvium establishes a transparent and competitive model based on the Orvium token. The complete process of manuscripts' and journals' life cycles such as manuscript submission, review, publication, journal and copyright management, and transfer process involves the exchange of Orvium tokens between the participating parties such as institutions, authors, owners, reviewers, readers, etc. Orvium aims to be the leading publication platform for the research community while returning the benefits of science to society. In addition, Orvium incorporates a unique and seamless integration of cutting-edge technologies to create a platform to process, validate, and disseminate research data and results. Author/contributor owns the copyright and licenses of the contribution and can transfer it through the Orvium tokens. The journal is maintained in a decentralized way leading to low maintenance and operational costs. Reviewers get immediate rewards and recognition through the platform on performing quality reviews. The manuscripts are linked with proof of existence. The entire Orvium community holds the promise of co-existence, transparency, control, and competitiveness.

Ripple[3]

Problem

The global payment and cross-border system account for $155 trillion. However, the settlement takes typically around 3–5 days contributing to $1.6 trillion annual costs. Moreover, the payment infrastructure is unreliable.

Almost 3 billion people are connected through online channels, and many of them perform transactions not only in one's jurisdiction but also in the cross-border jurisdictions for services and products. The centralized global payment system lacks effective inter-connectivity to deliver on the demands of today's customers.

Challenge

- instant on-demand settlement,
- low operational and liquidity costs,
- trackable payments,
- improve security,
- secure transactions, and
- remove paper works.

Description

Ripple provides a single distributed financial technology for frictionless transactions supporting real-time messaging, clearing, and settlement of the transactions. The participants of the ecosystem are categorized as network members (Enablers: banks and payment providers) and network users (Originators: consumers, corporates, others).

Solution

RippleNet is a decentralized network. The participating parties need to utilize the same technology and adhere to the standards and comply with the rules considering payments, etc. Ripple's xCurrent software supports value transfer between different ledgers and networks. Such transactions are traceable and secured. Besides, its interledger protocol (IPL) establishes new efficiency to settlements. For example, the parties can execute real-time settlements by removing settlement risks and ensuring transactions certainty. A real-time messaging platform provides a rich experience to its users to get informed about the transactions updates. All the transactions are immutable, secured cryptographically, and represent a single version of the truth. The software is architected in such a way that it can be integrated seamlessly within the existed banks infrastructure, thereby reducing banks disruption of activities and processes. The validator component confirms the success or the failure of the payments. The settlement risk of the atomic payments is removed as the payment processes entirely fail upfront.

STEEM[4]

Problem

The social media industry is prolifiering by the humongous growth of active contributors. As of April 2019, Facebook has 2.32 billion, and Twitter has 330 million active users. In most of the social media platforms, the primary revenue model is based on the offering of free services to the contributors in lieu of their data. These customers' data are then appropriately used to profile the customers and showcase them the relevant advertisement. Though the customers are the main contributor to the content, they get no monetary benefits, and they also lose their control on the content. The central authority takes control of the content and the way that it should be posted and shown to the other participants on the social community. These central authorities hold economic benefits and monetization rights on the data. The purpose of the social community is to produce content and curate it and get recognition, rewards, and monetary benefits.

Challenge

- provide inclusive social engagement,
- enhance efficiency,
- generate quality content,
- improve monetization,
- eliminate duplicate data, and
- produce original content.

Description

STEEM is a blockchain platform that promises to give rewards to the contributors and support social interaction. The ecosystem encourages participants to experience more inclusive engagement. The platform can be used to build and support decentralized applications and data storage.

Solution

STEEM is reimagining the social interaction and community contribution through reward, recognition, and quality content. It supports three primary tokens—Steem, Steem Dollar, and Steem Power. Steem is a native token that is transferable between accounts. Steem Dollar is a debt instrument which is claimable for $1 worth of Steem, while Steem Power is the staked Steem tokens which represent users' upvote value. The active contributors have been increased to 1.19 million users, and the distribution of rewards worth over $60 million has been achieved. It works on the delegated proof of stake. The platform keeps human-readability as one of the core designed aspects and

is scalable to support 1800 posts per second. Some of the popular DApps are as follows:

- Steemit: users can contribute content and curate it and earn from interactions.
- DTube: users can create quality video content and get steem rewards.
- Steem Monsters: users can collect card and battle in a captivating story-telling trading card game.
- Gambling Dice: users can gamble and dice.

Wave[5]

Problem

The supply chain management in the international, national trade involves many parties to execute the transactions. Such kind of involvement not only prone to risks but also give rise to delays and conflicts. Besides, the paper-work in the traditional bill of lading (BOL) regarding the shipment, generally the type of goods, quantity, and destination, is not untouched by the forgeries. The receiving parties must acknowledge the receivables and the same needs to be channelized through the supply chain to all the participating parties. The whole workflow is time-consuming, inefficient, and most of the time not transparent to the entire supply chain.

Challenge

- produce affordable services;
- enhance efficiency;
- reduce costs;
- secure documents;
- eliminate disputes, forgery, and duplicate data; and
- easy to use.

Description

Wave has developed a supply chain management solution using blockchain to manage international trade effectively. The decentralized peer-to-peer network facilitates free, open, and direct communication among the connecting parties such as carriers, banks, forwarders, traders, and other parties of the international trading supply chain. The Wave network is not prone to a single point of failure due to its design of a decentralized network and thus ensures cost-effectiveness and transparency.

Solution

Wave's peer to decentralized peer-to-peer network facilitates all its connecting participants to have direct communication and exchange of the documents. Wave application manages the ownership of the documents or goods in the transport. Most importantly, the traditional Bill of Lading (BOL) is seamlessly replaced by its application. Eliminating the paper-based work of validating the BOL along with the documents to generate the receipts and trigger the payments through banks, the Wave's application integrates the workflow. All the connecting parties can connect, and once the documents are verified and payment has executed, the ownership of the documents is done seamlessly. The documents are sent to the recipients, and the sender performs the transaction by changing the ownership of the documents on the blockchain. Such transactions are immutable, and at any given time, all the connecting parties on the supply chain can validate the ownership of the documents. As the ports receive the goods from the other port, the payment is observed when the ownership of the document is changed by executing the transaction.

ODEM[6]

Problem

The education industry is one of the most critical sectors projected to contribute to $10 trillion by 2030. Though many educational sectors have adopted some technological infrastructure and resources to impart educational programs end-to-end covering complete life cycle, it faces many challenges and barriers. Educational institutions lack transparency in student's evaluation and assessment. Also, the high tuition fee (online education) due to the presence of multiple layers of resellers, aggregators, and intermediaries are of significant concern to the learners. Further, the instructors and educators are not rewarded appropriately to develop content and programs considering the changing landscape of education. The validation of the education and academic certificates by the third party cause process delays, risks, forgery, huge costs, and more paper works.

Challenge

- produce a transparent and open evaluation and assessment,
- enhance learning efficiency,
- reduce costs,
- improve security,
- reward learners and educators, and
- remove paper works.

Description

ODEM is the decentralized, blockchain-based platform to empower learners to securely choose the educational programs and store proof of their educational experience. The smart contracts are helpful to settle the cross-border payments instantly. Further, identity and reputation are managed appropriately, which facilitates the learners to verify the educator's full credentials and teaching history.

Solution

ODEM ensures trust and transparency over the complete education life cycle. The platform seamlessly links artifacts related to organizing, administering, and sharing information pertaining to programs offering. The learners get to know the fit-to-learn program and initiate the learning when all the conditions are met. ODEM rewards both the learners and educators by transferring tokens to them. Each learner gets 25 ODEM tokens as rewards when he/she onboard a fellow learner and the learner completes the program. Educators also get tokens as rewards either by recommending fellow educators or onboarding past course students. Both the learners and educators can use tokens to avail education products and services over the ODEM platform. The learners can securely store and share proof of education certificates. It eliminates the fraudulent credentials by validating the candidates on the ODEM platform.

Sweatcoin[7]

Problem

The availability of sensors on the wearable devices has motivated many people to track and manage their physical activity. Though the native applications and the onboard (downloaded) third-party physical/health applications help individuals to design their daily and weekly schedule, considering their step counts, runs, heartbeat, etc., fails to provide any economic benefits. Moreover, the companies offering services through such applications have control of the users' data and thus monetize it for their interests.

Challenge

- produce transparent record-keeping and enhance tracking,
- increase motivation,
- improve monetization,
- establish marketplace, and
- make physical activity enjoyable.

Description

Sweatcoin monetizes the physical movements of the people. It maps the physical movement and in turn, provides the digital currency in the form of the tokens. These tokens then later can be used to buy goods and services or can be donated on the platform.

Solution

Sweatcoin is an application that uses blockchain to empower the users to convert their physical movement to the digital currency based on the tokens. Around 300 brands provide free products in the ecosystem, and users can buy such item based on the earned tokens and the product's tokenized value. Such an approach benefits both the brand and the user. First, the user gets motivation when his/her physical movement is converted to the digital currency, and that can be utilized to buy real products. Second, various brands can offer the products and verify the likelihood of purchasing the products by the users. It not only helps companies to position the brands but also to market them appropriately. The Sweatcoin takes a percentage of the currency whenever a user buys the products. Currently, the application measures the outdoor physical movements by considering the device's onboard step count tracking sensor, GPS coordinates, change in location, speed, and consistency of movements. The application aimed to provide instant gratification for physical activity. The firms offer 0.95 sweatcoins for every 1000 verified steps. A user can earn maximum of 5 sweatcoins covering 5000 steps under the regular membership model. The offer for the products begins only a user has earned 10 sweatcoins. A user can further upgrade his/her membership to the next level by giving 5 coins a month and then eligible to receive 10 coins every day. Further, a user can set the challenge for the physical movement and compete with the other users. Besides, the user can also transfer the sweatcoins to the other users.

PROVENANCE[8]

Problem

The provenance of the data is significant for every business. It can easily be altered, changed, modified, and updated. One can also forge the evidence of the source. The provenance is generally originated from the fine art world where a document proof validates the source of the artwork and also establishes that the artwork is not changed, stolen, or forged. The data provenance is a way by which one can identify the changes made into the data, its movements, who has made the changes, types of data ownership, etc. The supply of the products to the customers involves the distribution life cycle,

and each of the stages needs assurance of the quality of the products. Counterfeits and forged products are penetrating the global trade, and this is of significant concern as the supply chain complete distribution cycle is incapable of maintaining the provenance adequately considering cross-border movements.

Challenge

- establish trustworthy information,
- enhance efficiency,
- reduce costs,
- improve security,
- eliminate forged and counterfeits products, and
- create authentic traceability.

Description

PROVENANCE platform helps to bring trustworthy information to the point of sale, and thereby facilitates businesses to build brand trust. By utilizing the firm's transparency framework, it is easy to state the claims about company or products.

Solution

PROVENANCE platform is for both makers and sellers. The customers can verify the item or a batch source through the traceability tool. The sellers or makers can create a digital version of the product and link it via secure NFC or a DNA fingerprint. The authenticity of the ownership is then transferred to the point of sale and then to the customers who later owns the product. Each product is enabled by the digital passport indicating the authenticity and the origin. The platform helps in eliminating the counterfeits, fake goods, and "double-spending." The company believes in providing a competitive advantage by incorporating open, transparent supply chains, and manufacturing. The system eliminates the costly process of validating the claims and integrity of the product and difficult audits to establish authenticity.

Patientory[9]

Problem

The global annual health spending is going to cross over $8.7 trillion by 2020. The healthcare ecosystem faces a stiff challenge of maintaining, accessing, and controlling patients' data. At many places, the proper records for the patient data are not available. Moreover, as the data volumes are getting increased every year, it is becoming difficult for hospitals and clinics

to process, store, and manage data. Healthcare organizations typically manage data through patient healthcare information system (PHI), electronic health records (EHR), medical insurance claims, and data collected from IoT-enabled devices. To provide proper health care and services, it is essential for the healthcare organizations to verify the integrity of the PHI, EHR, clinical trial, and research data, reduce audit expenses, ensure data safety and regulatory compliances, and perform unaltered medical audits.

Challenge

- produce transparent PHI, EHR, and clinical data;
- enhance efficiency and reduce costs;
- improve security and perform unaltered medical audits; and
- eliminate duplicate data and remove paper works.

Description

Patientory is a blockchain-based platform that provides a more secure way to manage, process, and control data for patients, doctors, and healthcare organizations. The DApp excludes the intermediation that is data sharing. Each patient can create a unique profile on the DApp and able to track the health history. The profile and the relevant data are also shared with the concerned stakeholders to provide the necessary medication and track patients' health progress.

Solution

Patientory improves healthcare coordination while ensuring process efficiency and data security. It empowers patients, doctors, and healthcare organizations to store, share, and access information safely. The platform adheres to the regulatory guidelines and compliance and also ensures the end-to-end encryption of the information. Besides the HIPAA, compliant-protected information system, patients at any time can access their information and connect to the care community. The DApp provides significant benefits to doctors to manage their schedule, reminders, and electronic records. The platform offers decentralized, immutable access of the information to the stakeholders and also integrates the information with the wearable devices and mobile health apps. The patients can also discuss with the community over the platform and learn from their experience. The platform supports token, PTOY, which can be used over the platform to rent health information storage space and execute smart contracts to pay bills, settle medication, referrals, and gain rewards. The transaction is recorded on the blockchain, which can be traced for medication, health history, and Mediclaim.

Musicoin[10]

Problem

In the year 2017, the growth of the music industry was expanded to $17.3 billion. Besides, the streaming industry accounted for $6.6 billion. The music industry in the most original form suffers from copyright infringement and music theft. Moreover, the secrecy that is maintained about the sale of the music or its streaming over various channels makes the contributor unhappy. The royalty payouts and licensing monetization are inappropriate and majorly beneficial to the big brand and the distributors. Monopoly for individual record labels also creates very less space for the other channel or labels.

Further, there is no standard to handle the metadata regarding the users' usage of streaming data such as tracks, songs, and music usage in general. Though the user penetration to access and listen to music has increased exponentially, the royalty earned by the artist has not been raised proportionally. Many stakeholders in the music distribution, such as the record label, artist, and distributor make the royalty revenue model too complicated.

Challenge

- produce transparent and open music service,
- enhance efficiency,
- enhance royalty payout,
- improve security,
- eliminate music theft and copyright infringement, and
- instant payouts.

Description

Musicoin is the platform on the blockchain that supports the creation, distribution, and consumption of the creative artifact, music, in a shared economy. It is based on the universal basic income (UBI) model for rewarding the contributor fairly on account of the contributions. Currency MUSIC is used to support the music industry and perform the transaction related to the music-related business.

Solution

Musicoin platform supports smart contracts to instantly payout the musicians. The payout is based on the universal basic income and pay-per-play (PPP). Every time the user streams the song, the currency MUSIC is automatically transferred to the artist or the group. The UIB ensures that each contributor to the song is fairly rewarded and includes a PPP at a fixed rate without getting affected by the market forces. The platform is beneficial to all the stakeholders as MUSIC is transferred as and when the contribution is recognized

and validated. Moreover, the source and integrity of the contribution can be verified and traced to ensure secure, open, and transparent music service. User can also "tip" the musicians by transferring the MUSIC and artists can further deepen the relationships with their fans.

Web References

[1] https://www.vakt.com
[2] https://orvium.io
[3] https://ripple.com
[4] https://steem.com
[5] https://wavesplatform.com
[6] https://odem.io
[7] https://sweatco.in
[8] https://provenance.org
[9] https://patientory.com
[10] https://musicoin.org

Appendix

Worksheet

The organization entering into the blockchain space must consider some guiding principles that reflect their efforts and investments are aligned with the corporate priorities. Answer each of the questions with respect to your organization.

Which industry or domain you wish to work for the blockchain project?
Which market study you have performed to gauge the requirements? What criteria you have utilized?
Which particular segment you want to focus within your chosen industry/domain?
Explain why your chosen market segment is attractive for blockchain technologies.

N. Upadhyay, *UnBlock the Blockchain*,
https://doi.org/10.1007/978-981-15-0177-7

Identify your top three competitors and list down three strength(s) and weakness(es).

Competitor	Strength	Weakness
Competitor 1		
Competitor 2		
Competitor 3		

Identify the top three entry barriers that you and your competitors might face in your chosen market segment.

Company	Barriers
Your Company	
Competitor 1	
Competitor 2	
Competitor 3	

Problem in the Market Segment

It is important to define and describe the problem statement as it directly relates to the rationale of your project in the given market segment.

Identify the problem in the market segment.
Is there any way that you agree that there exists a problem or a need?
Are you aware of the target population to be served in the given market segment? Any specific details of interest?

Identify the requirements of the population in the chose market segment.
Are you sure that the set of requirements need specific solution?
Are you sure that you or your organization is the best one to offer the solution? Explain?

Is there a sync between the problem and mission of your organization?
Identify the way that blockchain can/cannot provide solution to the given problem in the chosen market segment.
Identify the problem statement.

Are you aware of any repeatable process that can be automated?
Are you aware of any long-run process?
Do you have multiple stakeholders in the process or a value chain?
Do you have any process by which reconciling of disparate data is achieved? Is that process involves single or multiple parties?
Do you have an element of value transaction? List value transactions.
Do you need an immutable record for the value transaction? Why or why not?

Blockchain Template—Idea Brainstorm and Evaluation

The following templates are useful to perform brainstorming and evaluation. Identify the domain, market segment, problem statement, and stakeholders involved in the project. Utilize checklist to identify the involvement of blockchain to offer the solution. In case any item in the checklist results in "No," then blockchain is not the appropriate solution as other technologies can be used to offer the solution for the problem. Illustrate and evaluate your top 10 ideas through blockchain idea barnstorm (BIB) and blockchain idea evaluation framework (BIEF).

Blockchain idea brainstorm (BIB) Template—Idea 1

Domain:

Market Segment:

Problem Statement:

Stakeholders:

Checklist	Yes	No
Do you need a database for the records?		
Do you have multiple members updating records in the database?		
Do these members need to trust each other?		
Do you have any third-party involvement?		
Do you face any problems with the third party?		
Does the transaction depend on each other?		
Do you have assets of "value" to be represented digitally?		
Potential Solution—Blockchain		

Blockchain idea brainstorm (BIB) Template—Idea 2

Domain:

Market Segment:

Problem Statement:

Stakeholders:

Checklist	Yes	No
Do you need a database for the records?		
Do you have multiple members updating records in the database?		
Do these members need to trust each other?		
Do you have any third-party involvement?		
Do you face any problems with the third party?		
Does the transaction depend on each other?		
Do you have assets of "value" to be represented digitally?		
Potential Solution—Blockchain		

Blockchain idea brainstorm (BIB) Template—Idea 3

Domain:

Market Segment:

Problem Statement:

Stakeholders:

Checklist	Yes	No
Do you need a database for the records?		
Do you have multiple members updating records in the database?		
Do these members need to trust each other?		
Do you have any third-party involvement?		
Do you face any problems with the third party?		
Does the transaction depend on each other?		
Do you have assets of "value" to be represented digitally?		
Potential Solution —Blockchain		

Blockchain idea brainstorm (BIB) Template—Idea 4

Domain:

Market Segment:

Problem Statement:

Stakeholders:

Checklist	Yes	No
Do you need a database for the records?		
Do you have multiple members updating records in the database?		
Do these members need to trust each other?		
Do you have any third-party involvement?		
Do you face any problems with the third party?		
Does the transaction depend on each other?		
Do you have assets of "value" to be represented digitally?		
Potential Solution—Blockchain		

Blockchain idea brainstorm (BIB) Template—Idea 5

Domain:

Market Segment:

Problem Statement:

Stakeholders:

Checklist	Yes	No
Do you need a database for the records?		
Do you have multiple members updating records in the database?		
Do these members need to trust each other?		
Do you have any third-party involvement?		
Do you face any problems with the third party?		
Does the transaction depend on each other?		
Do you have assets of "value" to be represented digitally?		
Potential Solution—Blockchain		

Blockchain idea brainstorm (BIB) Template—Idea 6

Domain:

Market Segment:

Problem Statement:

Stakeholders:

Checklist	Yes	No
Do you need a database for the records?		
Do you have multiple members updating records in the database?		
Do these members need to trust each other?		
Do you have any third-party involvement?		
Do you face any problems with the third party?		
Does the transaction depend on each other?		
Do you have assets of "value" to be represented digitally?		
Potential Solution—Blockchain		

Blockchain idea brainstorm (BIB) Template—Idea 7

Domain:

Market Segment:

Problem Statement:

Stakeholders:

Checklist	Yes	No
Do you need a database for the records?		
Do you have multiple members updating records in the database?		
Do these members need to trust each other?		
Do you have any third-party involvement?		
Do you face any problems with the third party?		
Does the transaction depend on each other?		
Do you have assets of "value" to be represented digitally?		
Potential Solution—Blockchain		

Blockchain idea brainstorm (BIB) Template—Idea 8

Domain:

Market Segment:

Problem Statement:

Stakeholders:

Checklist	Yes	No
Do you need a database for the records?		
Do you have multiple members updating records in the database?		
Do these members need to trust each other?		
Do you have any third-party involvement?		
Do you face any problems with the third party?		
Does the transaction depend on each other?		
Do you have assets of "value" to be represented digitally?		
Potential Solution—Blockchain		

Blockchain idea brainstorm (BIB) Template—Idea 9

Domain:

Market Segment:

Problem Statement:

Stakeholders:

Checklist	Yes	No
Do you need a database for the records?		
Do you have multiple members updating records in the database?		
Do these members need to trust each other?		
Do you have any third-party involvement?		
Do you face any problems with the third party?		
Does the transaction depend on each other?		
Do you have assets of "value" to be represented digitally?		
Potential Solution—Blockchain		

Blockchain idea brainstorm (BIB) Template—Idea 10

Domain:

Market Segment:

Problem Statement:

Stakeholders:

Checklist	Yes	No
Do you need a database for the records?		
Do you have multiple members updating records in the database?		
Do these members need to trust each other?		
Do you have any third-party involvement?		
Do you face any problems with the third party?		
Does the transaction depend on each other?		
Do you have assets of "value" to be represented digitally?		
Potential Solution—Blockchain		

Blockchain Idea Evaluation Framework (BIEF)

Blockchain idea evaluation framework—Idea 1

Blockchain Evaluation Lens			Description
Artifact	Value registry		
	Value transaction		
Legal			
Regulatory			
Finance	Sources of Funding		
	CAPEX		
	OPEX		
	Other transaction		
Operational	Resources	Primary	
		Secondary	
		Others	
	Partners		
	Activities		

Blockchain idea evaluation framework—Idea 2

Blockchain Evaluation Lens			Description
Artifact	Value registry		
	Value transaction		
Legal			
Regulatory			
Finance	Sources of Funding		
	CAPEX		
	OPEX		
	Other transaction		
Operational	Resources	Primary	
		Secondary	
		Others	
	Partners		
	Activities		

Blockchain idea evaluation framework—Idea 3

Blockchain Evaluation Lens			Description
Artifact	Value registry		
	Value transaction		
Legal			
Regulatory			
Finance	Sources of Funding		
	CAPEX		
	OPEX		
	Other transaction		
Operational	Resources	Primary	
		Secondary	
		Others	
	Partners		
	Activities		

Blockchain idea evaluation framework—Idea 4

Blockchain Evaluation Lens			Description
Artifact	Value registry		
	Value transaction		
Legal			
Regulatory			
Finance	Sources of Funding		
	CAPEX		
	OPEX		
	Other transaction		
Operational	Resources	Primary	
		Secondary	
		Others	
	Partners		
	Activities		

Blockchain idea evaluation framework—Idea 5

Blockchain Evaluation Lens			Description
Artifact	Value registry		
	Value transaction		
Legal			
Regulatory			
Finance	Sources of Funding		
	CAPEX		
	OPEX		
	Other transaction		
Operational	Resources	Primary	
		Secondary	
		Others	
	Partners		
	Activities		

Blockchain idea evaluation framework—Idea 6

Blockchain Evaluation Lens			Description
Artifact	Value registry		
	Value transaction		
Legal			
Regulatory			
Finance	Sources of Funding		
	CAPEX		
	OPEX		
	Other transaction		
Operational	Resources	Primary	
		Secondary	
		Others	
	Partners		
	Activities		

Blockchain idea evaluation framework—Idea 7

Blockchain Evaluation Lens			Description
Artifact	Value registry		
	Value transaction		
Legal			
Regulatory			
Finance	Sources of Funding		
	CAPEX		
	OPEX		
	Other transaction		
Operational	Resources	Primary	
		Secondary	
		Others	
	Partners		
	Activities		

Blockchain idea evaluation framework—Idea 8

Blockchain Evaluation Lens			Description
Artifact	Value registry		
	Value transaction		
Legal			
Regulatory			
Finance	Sources of Funding		
	CAPEX		
	OPEX		
	Other transaction		
Operational	Resources	Primary	
		Secondary	
		Others	
	Partners		
	Activities		

Blockchain idea evaluation framework—Idea 9

Blockchain Evaluation Lens			Description
Artifact	Value registry		
	Value transaction		
Legal			
Regulatory			
Finance	Sources of Funding		
	CAPEX		
	OPEX		
	Other transaction		
Operational	Resources	Primary	
		Secondary	
		Others	
	Partners		
	Activities		

Blockchain idea evaluation framework—Idea 10

Blockchain Evaluation Lens			Description
Artifact	Value registry		
	Value transaction		
Legal			
Regulatory			
Finance	Sources of Funding		
	CAPEX		
	OPEX		
	Other transaction		
Operational	Resources	Primary	
		Secondary	
		Others	
	Partners		
	Activities		

Idea Decision Matrix

Assess and evaluate the ideas utilizing the decision matrix. Include at least 10 criteria in the decision matrix. In case, the idea chosen is [not] the appropriate idea to execute and then explain the reason to [remove] select the particular idea.

Criteria weight (CW_i): Assign criteria weight or importance.

Idea score: Rate each idea on the criteria between score 1–10 [1 means least important and 10 means very strongly important].

	CW_1	CW_2	CW_3	CW_4	CW_5	CW_6	CW_7	CW_8	CW_9	CW_{10}	Total
Weight											
Idea 1											
Idea 2											
Idea 3											
Idea 4											
Idea 5											
Idea 6											
Idea 7											
Idea 8											
Idea 9											
Idea 10											

Explain your choice

Statement of Benefit

Identify the statement of benefit that reflects the benefits that customer gets when they adopt your idea.

Describe the statement of benefit.
Can you measure it? How?
Do you think that it is realistic?
Are you sure that it is customer focused? How?

Idea Positioning

Identify your idea positioning statement. Use the example template: (e.g., "For [*target customer/audience*] who [*statement of need or opportunity*], our [*name of product/service*] is [*product/service category*] that [*statement of benefit*]. Unlike [*primary competitive alternative*], our product [*statement of primary differentiation*]").

In what way your project offers new or added value to the customers?
Describe the idea positioning statement for your project.
Identify which positioning strategy is most appropriate and effective. **Strategy** / **Description** / **Priority** **Service** **Quality** **Access** **Scope** **Innovation** **Demographics**
In what way the project will affect the strategic positioning of your organization?
What changes your organization has been undertaken to **sustain** its positioning?

Blockchain Layer

Layers		Description
Protocol	What kind of blockchain, public, private, or hybrid, will solve the problem?	
	Do you have design constraints regarding speed, scalability, bandwidth, etc.?	
	How you utilize resources for the development? Do you hire a developer or partner with open source robust ecosystem?	
Network	Who will run a node?	
	Who has access to read rights?	
	Who has access to write rights?	
	What is the resource requirement at the given node?	
	What are the computing, storage and regulation requirements?	
	How the interoperability and integration are materialized?	
Application	Who is going to use the application?	

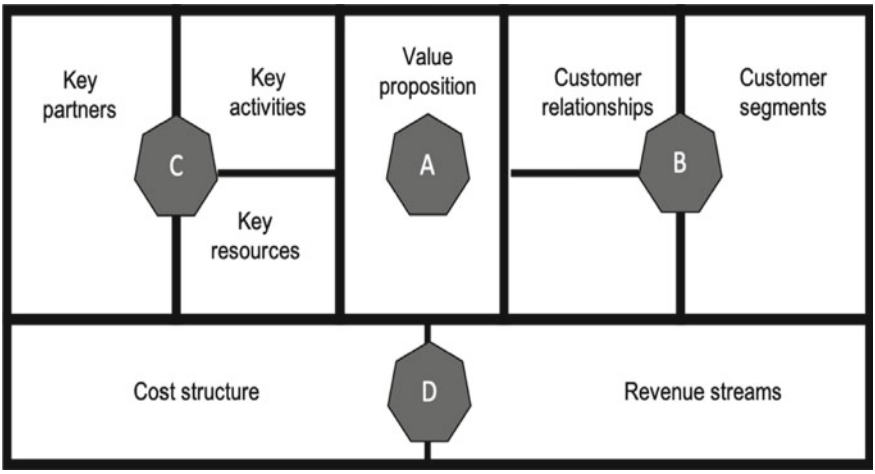
(continued)

(continued)

Layers		Description
	Are there any implications for user regarding interface, design, and experience?	
	In what way the service or a product serves the purpose?	
	Is there a requirement of changing any behavioral or structure aspects of an organization?	

Business Model Design

A **business model** provides the logic and rationale for how an organization creates, delivers, and captures value in economic, social, cultural, or other contexts. The process of developing (and modifying) a business model is an essential part of business strategy.



Dimension	A building block in business model canvas	Description
Product	Value proposition	
Customer interface	Customer segments	
	Channels	
	Customer relationships	
Infrastructure management	Key activities	
	Key resources	
	Key partners	
Financial aspects	Cost structure	
	Revenue streams	

Business Operations

Identify potential partners that can collaborate with you for streamlining processes, workflows, and business portfolios? In what way you can collaborate?
Does partnership have an impact on the transaction cost? How you trade-off between partnering and developing in-house capability?
Identify the business processes that can be reconfigured outside the organization's boundaries. Map those with the smart contracts.
Does your chosen project affect the strategic positioning of your organization?

How inclusion of smart contracts increases your competitive advantage?
How well you are aware of the partner capability and marketability? Are there any risks of losing your core business portfolios?
Identify the legal, regulatory, environmental, and political barriers for your project.

Business Model Capture

What problems, pains, and needs to be are of concerned to the customers and then provide the solutions accordingly?
Who are the potential customers and are there any specific category?
What are the revenue streams by which customer is willing to pay for the product and services?
How the communication is established with the customers? What are the channels for effective communication?
What kind of relationships exists with the customer?

What activities are necessary to offer value proposition, earn revenues, and reach markets?
What resources are essential to offer products or services?
Which collaborations are necessary to enrich value proposition?
What costs are involved to deal with the business models' infrastructure, activities, recourses, and customer relationship?

How to utilize blockchain to generate value?
Are there clear alignments of the organization's goals and strategies with the blockchain?
Does the organization have skilled resource and partnerships in place?
What are the major goals for the organizations in terms of customer segments, customer relationships, and value offerings?

Will blockchain help service customer needs better and offer more value?
Will blockchain tighten relationships inside the supply chain?
Does incorporation of smart contracts in the business processes reduce costs, risks, and delays?
Are there any improvements in the organizations' cost structures?
How easy or difficult to integrate blockchain with the existing infrastructure?
Does organization get competitive advantage with the blockchain?

Recall—Blockchain Innovation

Do customers experience better value and service?
Does blockchain establish participating and collaborating network of interest and value?
How easy or difficult to integrate blockchain with the organization's infrastructure and systems?
Is there an acceptable improvement in the cost structures by the inclusion of the blockchain?
How well the competitiveness of the organization is improvised?